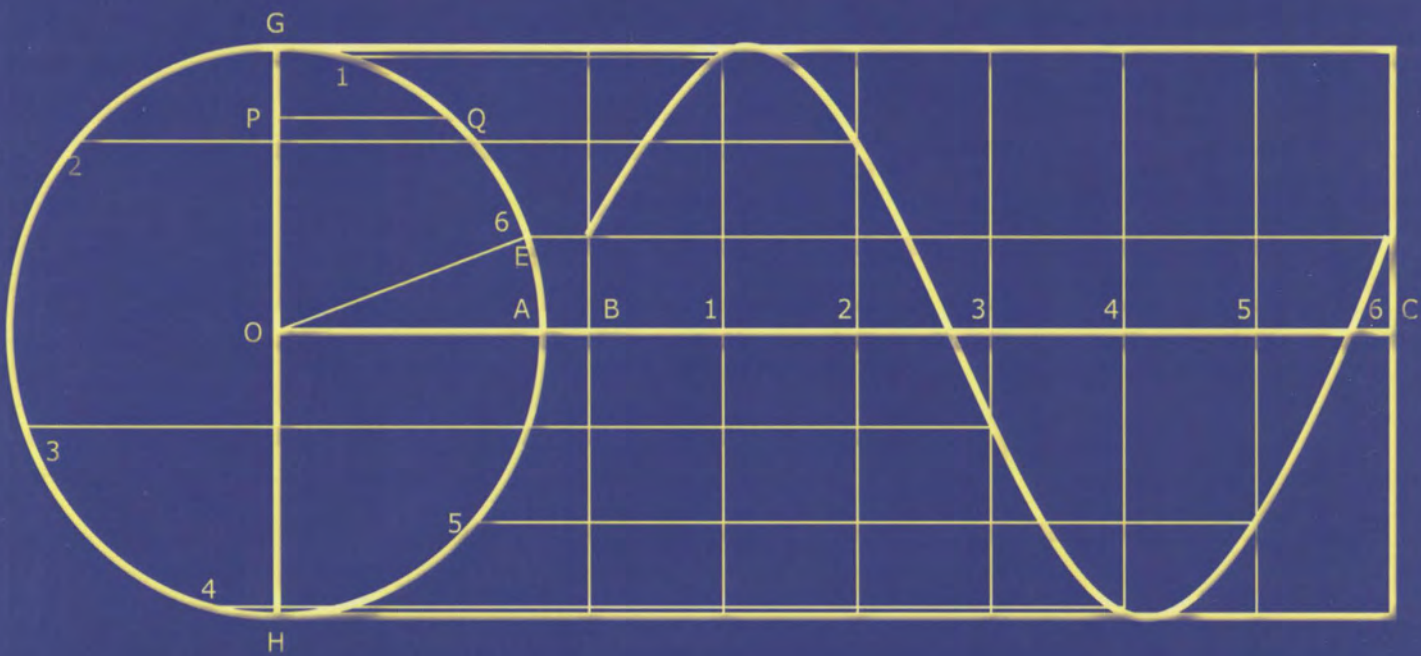


W.D. GANN

DIVINATION BY MATHEMATICS
HARMONIC ANALYSIS



AWODELE

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ISBN-13: 978-0615882079

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INTRODUCTION

For the majority of people who read this book, I expect that they will most likely already know a lot about W.D. Gann, but it always seems fitting to provide a little background information. William Delbert Gann was born on June 6, 1878 in Lufkin, Texas. In his promotional booklet issued in 1954, it says that he made his first trade in commodities on August 15, 1902, but it is said that his fame spread as a result of the December 1909 *Ticker and Investment Digest* magazine article written by R.D. Wyckoff, who was owner of the magazine at that time. In this article Gann talks about what he calls The Law of Vibration and how it enables him to accurately predict the points at which stocks will rise and fall within a given time. Numerous examples are given in the article where Gann predicts that a stock would not go higher or lower than a certain price. It goes on to say that in the presence of a representative of the *Ticker and Investment Digest* magazine during the month of October 1909, Gann made 286 transactions in various stocks during 25 market days and that 240 of the 286 transactions were profitable. It says that the capital with which he operated was doubled ten times so that at the end of the month he had 1,000 percent of his original margin.

In 1909, prior to this magazine article, there was a series of advertisements posted in the *New York Herald* that made claims similar to those of W.D. Gann. The advertisements only provided a business name with the title "OROLO", along with a street address. Although there is no authorship attached to the advertisements, we know that they were made by Gann based on their content. In one advertisement dated Sunday

April 18, 1909, the author states,

"I have proved after nine years of scientific investigation that it is possible to know every move the markets make. It is a scientific problem, not guess work, as many believe. I have investigated all "Systems," found most of them worthless to the average trader and none of them perfect. I investigated astrology and kindred sciences to learn the law of the movements in the markets. In them all there was something lacking, and not until I struck upon the law of vibration and attraction as applied in Wireless Telegraphy did I find the key to Wall Street. I find the different stocks grouped into families, each having its own distinct vibration, which acts sympathetically upon others of the group and causes them to move in unison. I now have perfected my theory until I can forecast every move in Stocks, Cotton and Wheat."

We see that Gann comes on the scene with these advertisements prior to the *Ticker and Investment Digest* magazine article dated December, 1909. In fact, he perfected his method as early as 1908. In his promotional booklet entitled, *Why Money is Lost on Commodities and Stocks and How to Make Profits* from 1954, it records the following:

"1908 May 12th left Oklahoma City for New York City. August 8th made one of his greatest mathematical discoveries for predicting the trend of stocks and commodities. Started trading with a capital of \$300 and made \$25,000. Started another account with \$130 and made \$12,000 in thirty days time."

In 1927, prior to selling any of his stock market or commodity courses, Gann published a novel entitled, *The Tunnel Thru the Air: Or Looking Back From 1940*. Many believe that Gann encoded his trading secrets in this novel. In the Foreword Gann writes,

"The "Tunnel Thru the Air" is mysterious and contains a valuable secret, clothed in veiled language."

In reading and studying Gann's novel for a number of years now, a certain set of passages always grabbed my attention and I wondered what he may have been referring to. This book is a result of my investigations concerning these passages and concerns itself with what Gann calls in his novel, the Law of Harmonic Analysis.

In my previous work, *W.D. Gann: Divination By Mathematics*, published in June of 2013, I wanted to stress to a wider audience that Astrology was not the main factor that Gann utilized to forecast future events. Even Gann said that in the 1919 *Milwaukee Sentinel* article which is analyzed in that book. In the article, Gann uses the science of letters and numbers to make predictions regarding the German Kaiser, Wilhelm Hohenzollern. In the analysis of that article, I showed how Gann may have used cycles and geometry to forecast the specific dates and periods mentioned. In this second book, I am continuing with the same theme with respect to the mathematical aspect of Gann's work, but based on certain passages within Gann's novel, *The Tunnel Thru the Air*. It is my belief that Gann was indeed trying to tell us something valuable in these passages, and this book outlines my research into what I believe Gann was talking about, and the application of what I found.

As I stated in my previous work, it is my hope that this will throw some light on the numerous theories written about Gann techniques and methods, and induce further research into the concepts presented herein.

Awodele,
Union, KY

September 11, 2013

1

HARMONIC ANALYSIS

In Chapter XVI of the novel entitled, *The Tunnel Thru the Air*, the main character, Robert Gordon, is engaged in a conversation with an older gentleman by the name of Mr. Henry Watson who he is introduced to by his friend Walter Kennelworth. Mr. Watson recounts many stories about individuals who made a success on Wall Street, but only to lose the majority of their profits in the end. Robert then asks Mr. Watson if anyone had ever made a large fortune out of Wall Street and kept it. Mr. Watson replied as follows:

"Oh, yes . . . if there were not exceptions to the rule, business would not continue to run. I could tell you of dozens of them, but one striking example is that of the late E. H. Harriman who died worth about three hundred million dollars. He had probably made out of the market a hundred million dollars in the last three or four years of his life. Robert asked, How did he do it? Mr. Watson answered, He stuck to one class of stocks - railroads. He studied them day and night, never diverted his attention to other lines. I believe that he possessed some mathematical method which enabled him to forecast stocks many months and years in advance. I have gone over his manipulations and the stocks he traded in, and found that they conform closely to the law of harmonic analysis. He certainly knew something about time and season because he bought at the right time and sold at the right time."

The first thing that stood out when I read this passage was the reference to E. H. Harriman. If you are familiar with the *Ticker and Investment Digest* article from December 1909, then you may already know where I am going with this. In this article, Gann writes as follows with respect to the Law of Vibration:

"In order to test the efficiency of my idea I have not only put in years of labour in the regular way, but I spent nine months working night and day in the Astor Library in New York and in the British Museum of London, going over the records of stock transactions as far back as 1820. I have incidentally examined the manipulations of Jay Gould, Daniel Drew, Commodore Vanderbilt & all other important manipulators from that time to the present day. I have examined every quotation of Union Pacific prior to & from the time of E. H. Harriman, Mr. Harriman's was the most masterly. The figures show that, whether unconsciously or not, Mr. Harriman worked strictly in accordance with natural law."

It is apparent that Gann thought highly of the manipulations of E. H. Harriman, so much in fact that he would add reference to him in his novel eighteen years after first mentioning him in the December 1909 *Ticker and Investment Digest* article. Not only that, but here we find that Gann is saying that Mr. Harriman worked strictly in accordance with natural law. Why is this important? In the very same article, Gann says as follows:

"I soon began to note the periodical recurrence of the rise and fall in stocks and commodities. This led me to conclude that natural law was the basis of market movements."

Gann is saying that he believes natural law to be the basis of market movements and that E. H. Harriman worked in strict accordance with this law. Furthermore, we have additional information from page 205 of Gann's novel as to what this may be. It is on page 205 where Mr. Watson says that he believed E. H. Harriman possessed some "mathematical method," which enabled him to forecast stocks many months and years in advance, and that his manipulations conformed closely to the law of harmonic analysis. Naturally, I wanted to know more about this mathematical method, and thought that it would be related to Gann's reference to the "law of harmonic analysis". It was here that my investigation into this this matter began.

When I typed in "Law of Harmonic Analysis" in the internet search engine, it returned less than 10 results, and the majority of those came from Gann's novel. However, when I typed in "Harmonic Analysis", it returned a number of pages. One was a Wikipedia entry that read as follows:

"Harmonic analysis is a branch of mathematics concerned with the representation of functions or signals as the superposition of basic waves, and the study of and generalization of the notions of Fourier series and Fourier transforms."

I was excited to hear that it was referring to a branch of mathematics since Gann's novel indicated that E.H. Harriman's possessed some "mathematical method". Wanting to find out more about this, I looked up Fourier series and found the following, which is also from Wikipedia.

"In mathematics, a Fourier series decomposes periodic functions or periodic signals into the sum of a (possibly infinite) set of simple oscillating functions, namely sines and cosines (or complex exponentials). . . The Fourier series is named in honour of Jean-Baptiste Joseph Fourier (1768-1830), who made important contributions to the study of trigonometric series, after preliminary investigations by Leonhard Euler, Jean le Rond d'Alembert, and Daniel Bernoulli. . . Fourier introduced the series for the purpose of solving the heat equation in a metal plate, publishing his initial results in his 1807 *Memoire sur la propagation de le chaleur dans les corps solides* (*Treatise on the propagation of heat in solid bodies*), and publishing his *Theorie analytique de la chaleur* in 1822. Early ideas of decomposing a periodic function into the sum of simple oscillating functions date back to the 3rd century BC, when ancient astronomers proposed an empiric model of planetary motions, based on deferents and epicycles."

Afterwards, I looked up Jean-Baptiste Joseph Fourier and found that he was a French mathematician and physicist and was best known for initiating the investigation of Fourier series and their applications to problems of heat transfer and vibrations. This, and the description of Fourier series tied a lot of things together for me. When you consider the fact that Gann said himself that he used mathematics to forecast markets, and the fact that we have the passage from the novel where Gann is making a reference to a branch

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of mathematics that deals with vibration analysis, it is hard to look away from this. Furthermore, when you consider what Gann said in the 1919 *Milwaukee Sentinel Magazine* article, that he made his discovery about twenty years ago, after weeks and months of research into geometry and mathematics in ancient books, and the fact that early ideas of decomposing a periodic function into the sum of simple oscillating functions date back to the 3rd century BC when ancient astronomers proposed an empiric model of planetary motions based on deferents and epicycles, it is even harder to look away. In the 1919 article Gann states,

"An astronomer can predict to the minute when an eclipse is going to occur . . . but you would not consider him a prophet, would you? Of course not, He simply makes use of mathematics based on known laws of the movements of the planets in their orbits. . . I use geometry and mathematics just as an astronomer does, based on immutable laws which I have discovered."

That said, I suspected that Harmonic Analysis may have been used by Gann in his work. In fact, there is more evidence in *Tunnel Thru the Air* where "harmonic analysis" is used in the only other place in that book. On page 77 in Chapter 7 on Future Cycles, the main character, Robert Gordon, writes the following in a letter dated January 28, 1927:

"The limit of future predictions based on exact mathematical law is only restricted by lack of knowledge of correct data on past history to work from. . . A few years ago even scientific men, not alone the public, would have laughed at such a thing and refused to believe it. But mathematical science, which is the only real science that the entire civilized world has agreed upon, furnishes unmistakable proof of history repeating itself and shows that the cycle theory, or harmonic analysis, is the only thing that we can rely upon to ascertain the future."

If you read the above passage carefully, you will realize that he is equating "harmonic analysis" with "the cycle theory". This is important to grasp because on page 75 in the beginning of the chapter, Robert Gordon says,

"In making my predictions I use geometry and mathematics, just as the astronomer does, based on immutable laws. . . My calculations are based on the cycle theory and on mathematical sequences."

Sound familiar? The first part of that passage is a carbon copy of what we found in the 1919 article. If we can come to the understanding that Gann is equating "the cycle theory" with "harmonic analysis" on page 77 of his novel, then couldn't the passage on page 75 also read,

"My calculations are based on harmonic analysis and on mathematical sequences."

Also consider that on page 23 of the novel, when Robert Gordon went to high school, Gann tells us the following:

"He took a great interest in physics and higher mathematics, studied day and night, making very high marks in these studies."

I understand that Robert Gordon was a great Bible student and was a great believer in Astrology, but his educational background was in higher mathematics. Once again, Gann was trying to tell us something.

The more I listened to what Gann was saying throughout the pages of *The Tunnel Thru the Air*, and the *Ticker and Investment Digest* article, I could hear him saying that Robert Gordon's calculations are based on harmonic analysis, which is also called the cycle theory. I could hear him saying that harmonic analysis is the same mathematical method that E. H. Harriman used to forecast stocks many months and years in advance, and I could hear him saying that harmonic analysis was the same method that he used to forecast the markets.

As I later learned, these ideas are not new. After a closer examination of the e-book entitled, *W.D. Gann on The Law of Vibration*, published by the Gann Study Group, the same ideas that you have read in this chapter are also in this e-book. In addition, harmonic analysis is associated with the subject of mathematics in a footnote on page 11 of the e-book as well. It reads as follows:

"HARMONIC ANALYSIS, in mathematics, the name given by Sir William Thomson (Lord Kelvin) and P. G. Tait in their treatise on *Natural Philosophy* to a general method of investigating physical questions, the earliest applications of which seem to have been suggested by the study of the vibration of strings and the analysis of these vibrations into their fundamental tone and its harmonics or overtones."

Not knowing what Harmonic Analysis was when I was heavily looking at the 1919 article, which is also in that same e-book, I simply overlooked these references.

That said, I must let the reader know that I do not consider myself a mathematician. At least, I did not major in mathematics and only took the necessary courses in college. Needless to say, after seeing the actual math involved, I was intimidated. It was downright overwhelming. Eventually, I set out to take the time to learn and familiarize myself with Trigonometry and Calculus on my own. Even with a little knowledge of these subjects, no matter where I looked or what kind of material I gathered to learn how to perform harmonic analysis, I was unable to grasp it. The descriptions of Harmonic Analysis & Fourier series such as those I provided in the preceding paragraphs didn't really help me to understand what it is, what it does, and how to apply it. If you are like me, you would like a simple, easy to understand explanation, and this is what I hope to provide in this book. To begin, considering the numerous documents, papers, and books I had collected on the subject, we will look at the one book that I thought was the best way for me to understand harmonic analysis in the next chapter.

2

HARMONIC ANALYSIS EXPLAINED

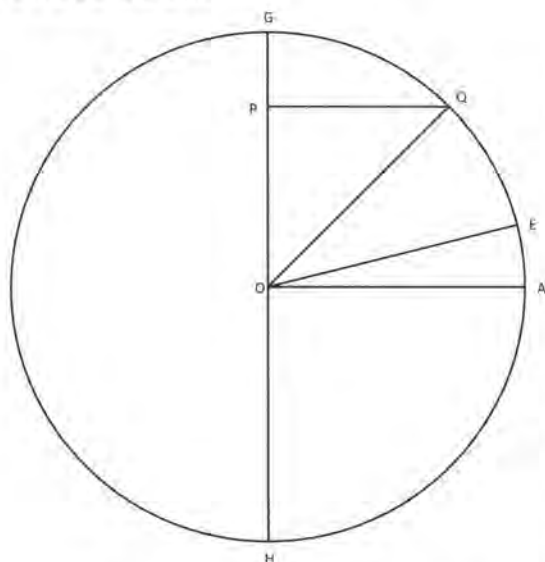
Personally, it was very hard to find any material that described how to perform harmonic analysis in a simple way. Especially for the person who does not have a background in mathematics. However, there was one book that I thought would be the best way for me to learn after reading through its contents. It is entitled, *Economic Cycles: Their Law and Cause* by Henry Ludwell Moore. In the book, Moore performs harmonic analysis on rainfall data in the Ohio Valley to ascertain the dominant cycles. He then shows how the dominant cycles of rainfall in the Ohio Valley are also present in the grain producing states of the Mississippi Valley. He proposes that the fluctuations in the amount of rainfall is controlled by well-defined cycles, and that this influences the variations in the yield per acre of crops. This affects the supply of commodities, which in turn affects its value in the market. Thus, if you can forecast the amount of rainfall in future periods of the grain producing states, you could predict their future prices. I don't know if I have adequately summarized all of the contents of his book, but it is in the public domain and can be obtained from Google books for free if you would like to check it out.

Since my goal at the time was to learn how to perform harmonic analysis, I focused on chapter 2, where the author provides a detailed explanation of harmonic analysis that is somewhat understandable, and describes the process of performing it on rainfall data in the Ohio Valley. I was thinking that if I could duplicate the calculations of the author, I would be well on my way to accomplishing my goal, but as you will see later in this chapter, this was no easy matter.

I think it will be proper to start with the explanation of harmonic analysis as described by Moore in his book, and then on to a more simpler explanation that I came across later on. With respect to the results of the second chapter, Moore writes this on page 7 of his book

"The method that was employed to reach the results of this chapter rests upon the analysis invented by Joseph Fourier, which is called, in English treatises, harmonic analysis. The perfection of the method whereby the findings may be subjected to the test of probability is the work of Professor Arthur Schuster of Manchester."

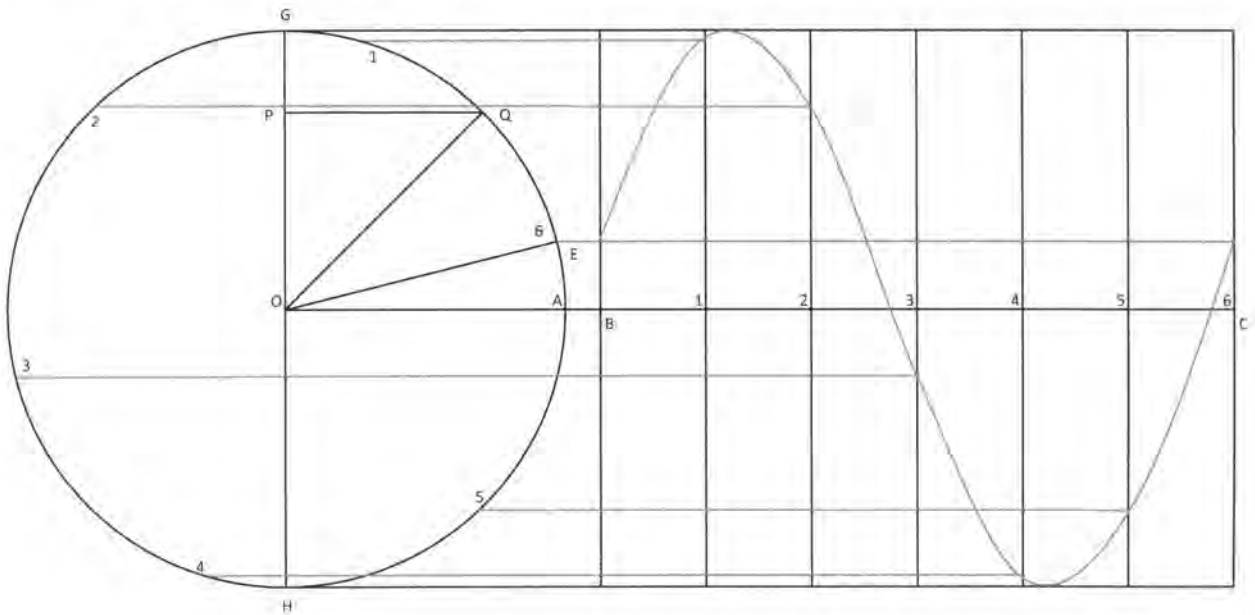
He then provides a graphic description of the terms that he is describing, which I have provided below.



"Suppose that point Q moves uniformly in the circle describing equal arcs in equal times and therefore, proportional arcs in different times. If the measurements of the arcs of the circle are made from point A and the reckoning of time is begun when Q is at E, the angle A O E is called the angle at epoch, or simply epoch of the uniform circular motion. The radius of the circle is the amplitude of the motion: the time of going once around the circle is the period of the motion; the ratio of A Q to the circumference of the circle is the phase of the motion.

If from each position of Q a perpendicular is dropped upon the diameter of the circle, G H, the foot of the perpendicular will describe a simple harmonic motion. The amplitude of the simple harmonic motion is one half of the range of the motion, that is, one-half of G H, or the radius of the circle. The period of the simple harmonic motion is the interval between the passing of the point P twice through the same position in the same direction. The distance of the point P from the middle of its range, O, is a simple harmonic function of the time, $OP = y = a \sin (nt + e)$, where a is the radius of the circle - or amplitude of the simple harmonic motion - e is the angle of epoch, and n is the angle described by the moving point Q in the unit of time. The period of the simple harmonic motion is, in the above case, $2\pi/n$. Its phase is $nt + e/2\pi$."

Figure 2 presents a graph of simple harmonic motion. As in Figure 1, the point Q moves uniformly in the circle; the point P performs simple harmonic motion according to the formula $y = a \sin (nt + e)$, where a is the amplitude of the motion, or radius of the circle, e is the angle of epoch, namely $A O E$, and n is the arc described by Q in the unit of time. If time is measured upon the line B C, the sinuous curve below is the graph of the function, $y = a \sin (nt + e)$.



Moore goes on to say on page 10,

"The importance of simple harmonic functions in the study of periodic phenomena grows out of the fact that any periodic curve however complex can be expressed mathematically by a series of simple harmonic functions."

This means that no matter how chaotic or complex the prices on a stock chart appear to be, if the values are indeed periodic, it can be expressed mathematically. There are some that may argue that there is nothing periodic about a stock chart, but Gann thought otherwise. In *The Ticker and Investment Digest* article from 1909 he says,

"I soon began to note the periodical recurrence of the rise and fall in stocks and commodities. This led me to conclude that natural law was the basis of market movements."

With the help of Fourier's analysis, a periodic function may be expressed as a Fourier series, where y is expressed as a series of sines and cosines. The series is of the form

$$y = f(t) = A_0 + a_1 \cos kt + a_2 \cos 2kt + \dots \\ + b_1 \sin kt + b_2 \sin 2kt + \dots$$

The problem lies in determining the values of the first term, which is A_0 , and of the coefficients of the sines and cosines, which are a_1 , a_2 , b_1 , b_2 , etc. Moore goes on to show you how to determine the algebraic values of the coefficients in the Fourier series, which involves some integral calculus. I will not reproduce the method of deriving those formulas here, but I will give you the main formulas later on. Moore then moves on to the problem of performing harmonic analysis on rainfall data recorded in the Ohio Valley.

In the appendix at the end of the chapter, he provides you with a table of the data for annual rainfall in the Ohio Valley recorded in inches for 72 years starting in 1839. In another table, he provides you with the calculated values of the coefficients in the Fourier series. Unfortunately, he doesn't walk you through putting the data in the formulas to calculate the results. No matter what I tried, I just could not duplicate the numbers in his table. I can't tell you how many books, articles, etc., where I looked for a simple explanation on how to plug the data into the formulas to calculate the coefficients, but to no avail. In the back of my mind, I knew I was having trouble setting up the problem and that's why my calculations did not match.

After some considerable time and frustration, I had an idea to reach out to mathematics professors at the University where I graduated. I went to the website for the University and looked up the contact information for professors specializing in Harmonic Analysis. There were three that I noted. I sent e-mails to all three indicating that I was an alumni, and although I did not graduate from the department of mathematics, that I loved studying cycles and needed some help calculating the numbers in Moore's book. I provided them with all the data in an excel spreadsheet along with an explanation of what I was trying to do.

One of those professors did respond, and said that he shared my puzzlement as to how the author calculated the coefficients, a_1 & b_1 , but thought it had something to do with the origin of time, that the author chose $t=0$ instead of $t=1$. He said that he was busy at the moment, but to give him time and he would send a more detailed explanation soon. About a week later he responded, and said that to reproduce the computations in the book, he used a Riemann sum to approximate the integral. He also attached a spreadsheet that did the computations, and said he was still puzzled by some of the

values in the book and was not convinced that he had given me the best way to find the coefficients. However, after taking some time to see how he set up the problem, I understood where I was making my mistakes. It helped me tremendously. In addition, I had later figured out that Moore was doing something else to some of the coefficients after they were calculated, which caused a difference between some of the values he had and the values I calculated. Needless to say, I can't thank that professor enough for taking the time to explain what he did when he didn't have to.

With the knowledge of how to calculate the coefficients, I went to work to reproduce all of the calculations and graphs from Chapter 2 of Moore's book. I will walk you through this process in the next chapter, but first, I would like to provide you with the most simple explanation of Harmonic Analysis that I came across during my research that helped me to understand what the math was actually doing. I can't remember exactly where I heard this from as it has been some time, but it went something like this. Imagine that you have a smoothie, and let's say that you don't know all of the ingredients that were blended together to make that smoothie. We can say that Harmonic Analysis will allow you to extract the individual ingredients that were blended together to make the smoothie. In other words, it will enable you to identify what those ingredients are. Now, if you were to recombine the major ingredients that you were able to identify, you would be able to create a smoothie that somewhat looked and tasted like the original.

If you can now think of the price values plotted on a stock chart as representing the smoothie, we can say that its ingredients are composed of a number of periodic cycles of various lengths. Thus, Harmonic Analysis will enable us to identify the dominant cycles that make up the graph of the value of stock prices over time. The dominant cycles can be identified in the calculated values of the coefficients of the Fourier Series, which can also be graphed to display the most dominant values. Furthermore, through the use of the formula for a Fourier Series, we can take the values of the coefficients representing the most dominant cycles and recombine them to produce a periodic waveform that mimics the graph of the original data. Not only that, but this formula also allows us to project that curve into the future many months and years. Doesn't that sound familiar to the mathematical method of E. H. Harriman that allowed him to forecast stocks many months and years in advance?

With the above having now been given, I will now show you how to perform Harmonic Analysis by walking through Moore's example on rainfall in the Ohio Valley in the next chapter, but hopefully, in a way that is easier to grasp and understand for those of us who don't have backgrounds in higher mathematics.

3

HARMONIC ANALYSIS APPLIED

First and foremost, we need the data that we wish to perform harmonic analysis on. Moore provided that in a table, which I have reproduced below.

Year	Rainfall In Inches	Year	Rainfall In Inches	Year	Rainfall In Inches	Year	Rainfall In Inches	Year	Rainfall In Inches	Year	Rainfall In Inches
1839	29.92	1851	32.54	1863	37.95	1875	44.78	1887	38.00	1899	40.46
1840	42.84	1852	46.73	1864	36.68	1876	47.34	1888	46.19	1900	33.60
1841	43.94	1853	35.67	1865	48.93	1877	34.69	1889	37.06	1901	31.78
1842	41.89	1854	40.30	1866	47.37	1878	36.35	1890	55.43	1902	39.53
1843	48.20	1855	47.89	1867	40.72	1879	39.22	1891	40.68	1903	37.98
1844	37.95	1856	28.98	1868	46.87	1880	49.94	1892	36.96	1904	28.24
1845	40.11	1857	37.95	1869	41.29	1881	41.60	1893	40.80	1905	42.81
1846	48.39	1858	55.48	1870	37.46	1882	56.10	1894	31.07	1906	41.95
1847	55.26	1859	46.68	1871	29.91	1883	49.25	1895	29.06	1907	46.68
1848	44.97	1860	36.00	1872	32.90	1884	40.05	1896	39.22	1908	33.29
1849	46.37	1861	43.81	1873	45.18	1885	37.63	1897	44.80	1909	41.40
1850	54.77	1862	40.26	1874	38.48	1886	39.61	1898	45.04	1910	36.20

There are 72 years worth of data, where I have 12 years in each of 6 columns. The first thing to be done is to calculate the first term, which is A_0 , and the coefficients of the Fourier series, which are a_1 and b_1 .

As I mentioned in the previous chapter, Moore goes through a process showing you how these formulas are derived. Below is the process by which the constant term in the Fourier series, A_0 , is derived.

12 *Economic Cycles: Their Law and Cause*

$$\int_0^T \cos mkt \cos nkt \, dt = 0,$$

$$\int_0^T \sin mkt \sin nkt \, dt = 0,$$

$$\int_0^T \sin mkt \cos nkt \, dt = 0.$$

The lemma may be proved to be true by evaluating the three integrals according to the usual methods. The first integral, for example, becomes

$$\begin{aligned} \int_0^T \cos mkt \cos nkt \, dt &= \frac{1}{2} \int_0^T \{ \cos (m-n)kt + \cos (m+n)kt \} \, dt \\ &= \left[\frac{\sin (m-n)kt}{2(m-n)k} + \frac{\sin (m+n)kt}{2(m+n)k} \right]_0^T \end{aligned}$$

But $k = \frac{2\pi}{T}$, and, consequently, $\int_0^T \cos mkt \cos nkt \, dt = 0$.

With the aid of this lemma we may proceed to evaluate the coefficients in Fourier's series. If we integrate the series between the limits 0 and T , we get,

$$\int_0^T f(t) \, dt = A_0 \int_0^T dt + a_1 \int_0^T \cos kt \, dt + b_1 \int_0^T \sin kt \, dt + \dots$$

But all of the terms except the first on the right-hand side of the equation will vanish, and consequently

$$\int_0^T f(t) \, dt = A_0 \int_0^T dt = A_0 T, \text{ or } A_0 = \frac{\int_0^T f(t) \, dt}{T}$$

Since $\int_0^T f(t) \, dt$ is the area of the original curve for one whole period T , the constant term in Fourier's series is equal to the value of the mean ordinate of the original curve.

As Moore states at the very bottom of the previous page, the constant term in Fourier series is equal to the value of the mean ordinate of the original curve. This means that A_0 is equal to the average of the 72 years worth of rainfall. In other words, add up all the 72 years worth of data and divide by 72. The value for A_0 given by Moore in the book is 41.19. When I perform the calculations in an Excel spreadsheet, I get 41.18653 as the average. He simply rounded up, keeping in mind that during Moore's time, these calculations would have to be done by hand. In fact, he does describe performing these calculations as laborious.

For those interested in deciphering the final formula which I have re-pasted below, this is what I think it is saying.

$$A_0 = \frac{\int_0^T f(t) dt}{T}$$

That symbol that looks like a cursive F without the horizontal slash means to integrate. This would be considered a definite integral in calculus because you are integrating between the limits of 0 and 72, and 72 is a definite number, which are the number of years worth of data that we have. The 0 is at the bottom of the integration symbol, and the T at the top would be where you would plug in the 72. $f(t)$ is a function. That is, for every instance of t , which is the time, you get a value for rainfall, but you add them all up due to the integration symbol before you divide by T at the bottom, which is 72, the limit of the integration. This will give you the value 41.18653. The "dt" at the end of $f(t)$ simply means that it is a derivative, but like I said before, I am no mathematician, so this may not be the most mathematically sound description, but I thought it would be helpful for those who are interested.

The next step is to calculate the coefficients of the Fourier series, which are a_1 and b_1 . This is what gave me the most trouble, because I didn't know how to set up the problem correctly. Moore's process for deriving the formulas is given on the following page if you would like to take a look. First, let's look at how to calculate a_1 , which is as Moore states, twice the mean value of $f(t) \cos kt$. To calculate a_1 , you can plug your data into the following formula:

$$(2/N) * (\text{rainfall amount}) * \cos(2 * \pi * (t)/(T))$$

To determine the value of a_1 , multiply throughout by $\cos kt$ and integrate between limits o and T .

$$\int_0^T f(t) \cos kt \, dt = A_0 \int_0^T \cos kt \, dt + a_1 \int_0^T \cos^2 kt \, dt \\ + b_1 \int_0^T \sin kt \cos kt \, dt + \dots$$

Or $\int_0^T f(t) \cos kt \, dt = a_1 \int_0^T \cos^2 kt \, dt$, since $\int_0^T \cos kt \, dt$ and $\int_0^T \sin kt \cos kt \, dt$ are both equal to zero and all the other terms on the right-hand side of the equation, according to our lemma, disappear. But

$$\int_0^T \cos^2 kt \, dt = \int_0^T \frac{1 + \cos 2kt}{2} \, dt = \frac{1}{2} \left[t + \frac{\sin 2kt}{2k} \right]_0^T = \frac{T}{2}$$

and as a result, we have

$$a_1 \frac{T}{2} = \int_0^T f(t) \cos kt \, dt, \text{ or } a_1 = 2 \frac{\int_0^T f(t) \cos kt \, dt}{T}$$

Therefore a_1 is equal to twice the mean value of the product $f(t)\cos kt$.

In a similar manner the value of any other coefficient may be determined. Take, for example, b_n . Multiply throughout by $\sin nkt$ and integrate between o and T ,

$$\int_0^T f(t) \sin nkt \, dt = b_n \int_0^T \sin^2 nkt \, dt = b_n \int_0^T \frac{1 - \cos 2nkt}{2} \, dt = \\ b_n \left\{ \frac{1}{2} \left[t - \frac{\sin 2nkt}{2nk} \right]_0^T \right\} = b_n \frac{T}{2}$$

and, consequently, $b_n = 2 \frac{\int_0^T f(t) \sin nkt \, dt}{T}$. Therefore b_n

In this formula, $(2/N) * (\text{rainfall amount}) * \cos(2\pi * (t)/(T))$, the first variable that I need to explain is T.

T is equal to the cycle number that you are analyzing for. In other words, we know that we have 72 years of data, so if we would like to calculate the coefficient a_1 with respect to an 8 year cycle, we would plug the number 8 in for T. Also worth nothing is the fact that you may have calculations for a number of cycles ranging from 3 years all the way up to maybe 36 years, which is half the total number of observations in the data.

Moving on, N is going to be equal to the total number of years that T can produce without going over the total number of our observations. For example, if we are looking at an 8 year cycle, this can repeat up to 9 times without going over 72, the total number of observations. The rainfall amount is going to be the amount of rainfall recorded in a given year, and t is going to be a number ranging from 0 to 71, which includes all of the data at our disposal. Just to analyze the influence of an 8 year cycle, you will actually be using the above formula to calculate the coefficient 72 times, that is, once for each value of t ranging from 0 to 71. When t is equal to 0, the amount of rainfall to plug in should be equal to the first year of rainfall. Where t is equal to 1, the amount of rainfall to plug in should be equal to your second year of rainfall. Afterwards, you will get 72 values for a_1 , which will need to be added together to obtain the final value for a_1 . See the screen shot below.

Year	Inches	t	Inches	#	N	T	a_1	b_1
1839	29.92	0	29.92	72	72	8	0.8311	0.0000
1840	42.84	1	42.84	72	72	8	0.8415	0.8415
1841	43.94	2	43.94	72	72	8	0.0000	1.2206
1842	41.89	3	41.89	72	72	8	-0.8228	0.8228
1908	33.29	69	33.29	72	72	8	-0.6539	-0.6539
1909	41.40	70	41.40	72	72	8	0.0000	-1.1500
1910	36.20	71	36.20	72	72	8	0.7110	-0.7110
							-3.1334	2.6937
							9.8182	7.2563
							17.0745	

As you can see in the first column, I have the year and the associated value for the amount of rainfall in inches. Skipping over some years to save space, at the bottom is the average for the 72 years rounded to two decimal places, which is the constant term in the Fourier series, A_0 . I have all the components of the formula in separate columns to make it easy to copy and paste without having to alter anything. Thus, in the column labeled a_1 , I am using the formula at the top of this page, (slightly modified for Microsoft

Excel), to calculate the value a_1 for every instance of t on down to the bottom. These values are totaled and this is where you will see the calculated value of a_1 as -3.1334. On page 17 of Moore's book, you will see that he has this value calculated as -3.1339.

Also in the screenshot on the previous page, we also do the same thing to calculate b_1 , but the formula is slightly different where in this instance you are calculating the SINE instead of the COSINE. It is as follows:

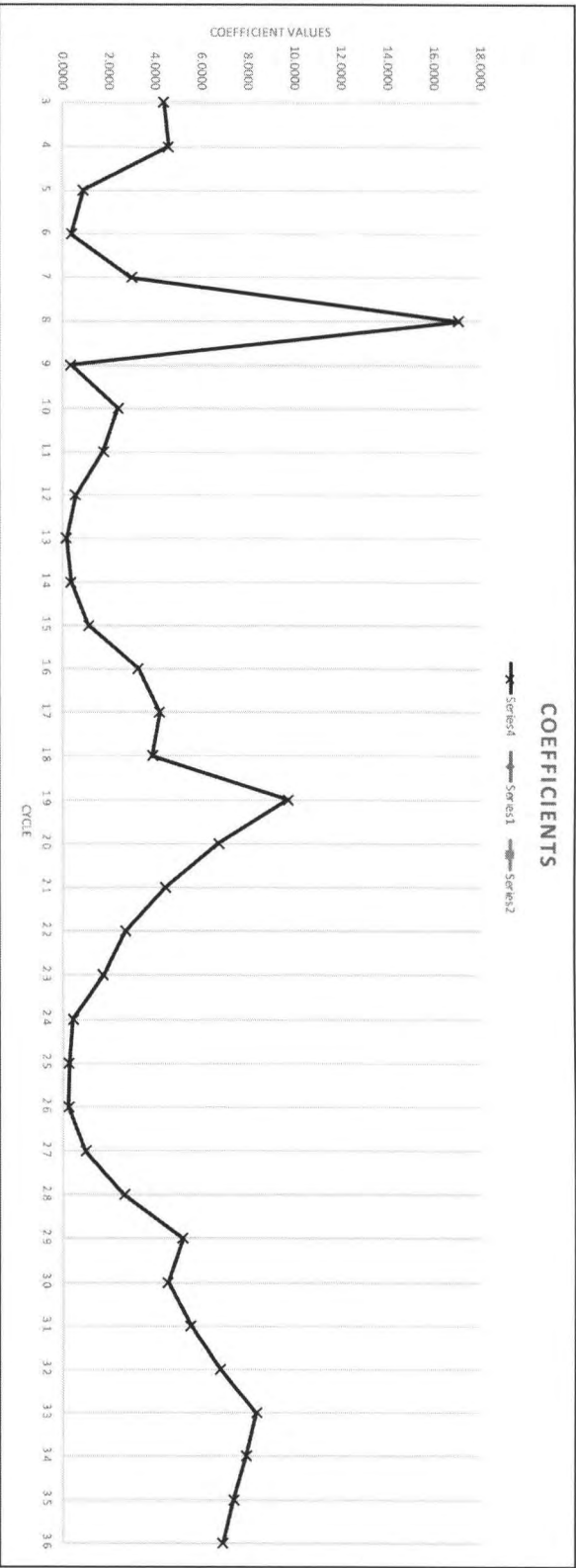
$$(2/N) * (\text{rainfall amount}) * \sin(2 * \pi * (t)/(T))$$

The calculated value for b_1 with respect to an 8 year cycle is 2.6937 rounded to 4 decimal places. The value in Moore's book is 2.6938. Also in the spreadsheet you will notice that the final value of each coefficient is squared and then added together to obtain a value of 17.0745. I believe squaring is done to make it easier to graph as this is the value that is used to determine which cycles seem to be the dominant cycles within the data. Just like we calculated this value for the 8 year cycle, we would also need to calculate this value for all the possible cycles ranging from 3 years to 36 years, where you would plug in these values for T . To make it easy to enter the data, I set up my spreadsheet where all I need to do is copy and paste a section of columns with the complete calculations as shown in the screen shot below. Notice the different values for T in each section of the spreadsheet. This goes all the way out to where T is equal to 36.

Year	Inches	t	Inches	#	N	T	a_1	b_1	t	Inches	#	N	T	a_1	b_1	t	Inches	#	N	T	a_1	b_1
1839	29.92	0	29.92	72	72	3	0.8311	0.0000	0	29.92	72	72	4	0.8311	0.0000	0	29.92	72	70	5	0.8549	0.0000
1840	42.84	1	42.84	72	72	3	-0.5950	1.0306	1	42.84	72	72	4	0.0000	1.1900	1	42.84	72	70	5	0.3782	1.1641
1841	43.94	2	43.94	72	72	3	-0.6103	-1.0570	2	43.94	72	72	4	-1.2206	0.0000	2	43.94	72	70	5	-1.0157	0.7379
1842	41.89	3	41.89	72	72	3	1.1636	0.0000	3	41.89	72	72	4	0.0000	-1.1636	3	41.89	72	70	5	-0.9683	-0.7035

Once you obtain a value for each cycle number like we did for 8 years of 17.0745, the next step is to graph the results. This is shown on the following page. Notice that the 8 year cycle appears to be the most dominant within the data. Also, 19 and 33 years are noteworthy. Note the fact that every 8 years, the Earth and Venus return to approximately the same position with respect to the Sun. Likewise, so does Earth and Mercury in 33 years. Just check out a geocentric ephemeris. 19 years is also the well known Metonic Cycle. Now that we have values for the constant term and the coefficients of the Fourier series, we can plug these values into our formula. Recall that a periodic function may be expressed as a Fourier series, where y is expressed as a series of sines and cosines and that the series is of the form:

$$y = f(t) = A_0 + a_1 \cos kt + a_2 \cos 2kt + \dots + b_1 \sin kt + b_2 \sin 2kt + \dots$$



Graph of the Coefficients of Rainfall Data in the Ohio Valley
Showing Cycles of 8, 19, & 33 Years Most Prominent

W.D. GANN: DIVINATION BY MATHEMATICS: HARMONIC ANALYSIS

Written a little differently so that you can see where the numbers should go, the formula should look like this:

$$A_0 + ((a_1) * (\cos(2 * \pi * t / N)) + ((b_1) * (\sin(2 * \pi * t / N))))$$

The constant term and the coefficients we already know. N is equal to the cycle number that we want to graph. In our example, let's say that we would like to graph the cycle of 8 years so the formula would look like this after you plug in the numbers.

$$41.19 + ((-3.1334) * (\cos(2 * 3.1416 * t / 8)) + ((2.6937) * (\sin(2 * 3.1416 * t / 8))))$$

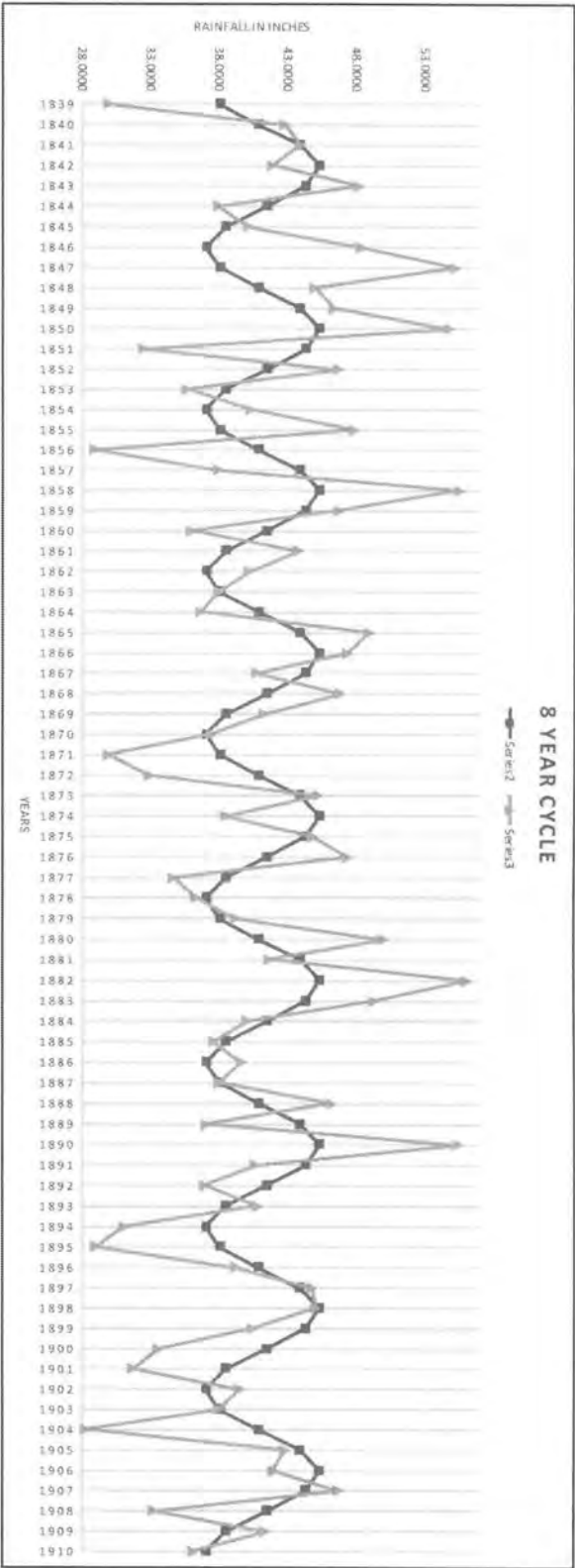
Notice the t once again represents the number of observations in your original data, which ranges from 0 to 71, where zero is considered the origin. Thus, if you plugged in 0 for t, you would get

$$41.1865 + (-3.1334) = 38.0531.$$

Note, when t is 0, the Sine portion of the equation is 0 so you just have the Cosine portion remaining. Thus, this is our value for y. In my spreadsheet, you can see how I set up the calculations in the screen shot below.

t	Year	a ₁	b ₁	N	y(t)	A ₀	
0	1839	-3.1334	2.6937	8	-3.1334	41.1865	38.0531
1	1840	-3.1334	2.6937	8	-0.3109	41.1865	40.8756
2	1841	-3.1334	2.6937	8	2.6937	41.1865	43.8803
3	1842	-3.1334	2.6937	8	4.1204	41.1865	45.3069
69	1908	-3.1334	2.6937	8	0.3109	41.1865	41.4974
70	1909	-3.1334	2.6937	8	-2.6937	41.1865	38.4928
71	1910	-3.1334	2.6937	8	-4.1204	41.1865	37.0661

Now, after obtaining a value for y for every one of our original observations and added to the constant term A₀ as shown in the column to the far right above, we can plot these values on a graph. On the following page you will see a graph of our 8 year cycle plotted against the actual values for rainfall observed during the 72 year span. One of the most important things that Harmonic Analysis can reveal is when the 8 year cycle peaks and when it bottoms. The first peak occurs in 1842, and the next occurs in 1850.



Graph of the 8-year Cycle of Rainfall in the Ohio Valley
Plotted Against a Graph of the Actual Rainfall Amounts Recorded in Inches

Series 2 - 8 Year Cycle

Series 3 - Actual Rainfall Amounts

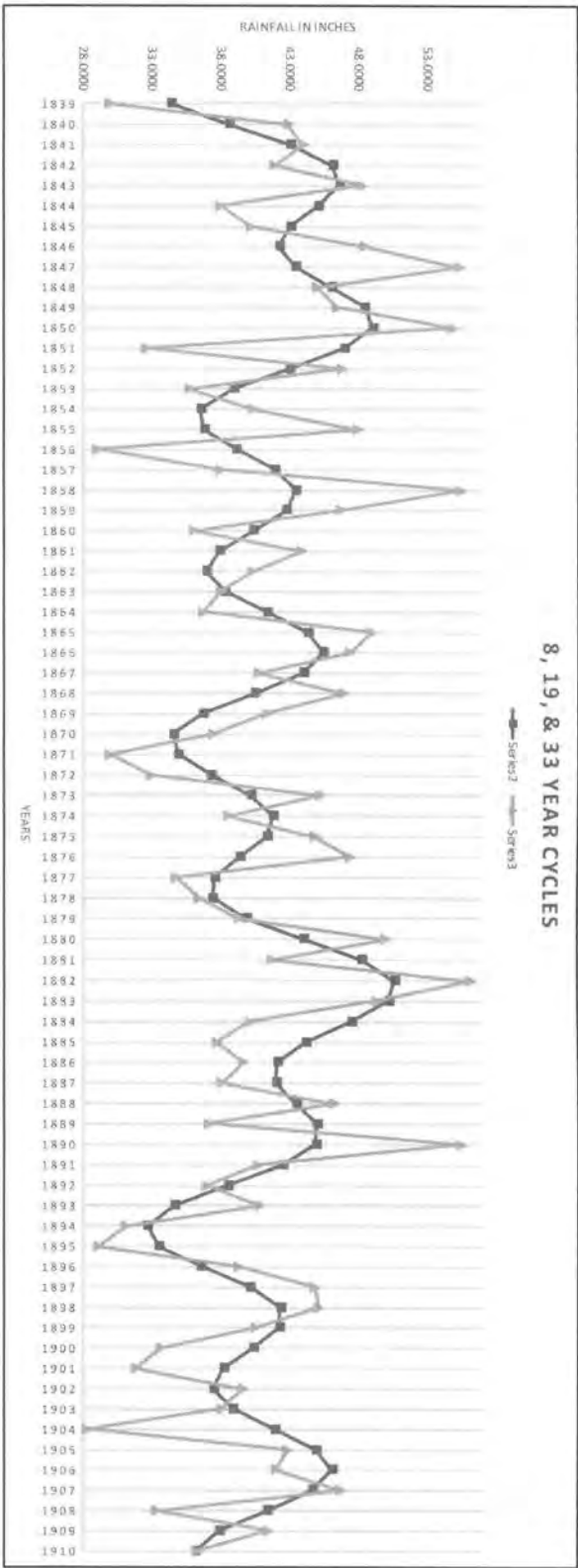
Now, using the Fourier Series formula, we can also combine several cycles together. Recall that 19 and 33 years also appeared to be dominant within the data. If we simply add the calculated values for y for each of these cycles to the values for the 8 year cycle, and add the constant term A_0 to all of these, we get the graph on the following page. Notice how the addition of the 19 and 33 years cycles has altered the curve. You can play with adding more cycles or taking cycles away, etc. Personally, my goal is to try to get a curve that mimics that original data as best as possible, but there are some things that will modify your approach as you gain more experience performing this type of analysis on various sets of data.

Now here comes the most exciting part about all of this. Using the same Fourier series formula, all we have to do to project into the future is to increase our value for t . Recall that our first observation was labeled 0, and the last of the 72 years worth of data was labeled 71. If I want to project 1 year into the future, all I have to do is plug in the number 72, and if I want to project 2 years into the future, 73. There is no limit to how far in the future you can forecast. If you have your spreadsheet set up properly, all you should need to do is copy the last row of data where t is equal to 71 in our example, and paste it in however many rows below it and the calculations should be done for you. When you include the extra values that are generated in the graph, you get a curve that projects past the point where the actual data for rainfall ends. In the next screen shot two pages over, you will see a graph where I projected 20 years into the future. This is what we would expect rainfall in the Ohio Valley to do in the next 20 years after 1910 based on past historical cycles. This area is circled on the graph. Also notice that I have added cycles of 4 & 29 years to the most dominant cycles of 8, 19, & 33 years.

It is nothing more than saying that based on the cycles that have already occurred with respect to the data being analyzed, I expect those same cycles to repeat in the future. More importantly, the formula provides us a clear picture of how those cycles will work together to produce the peaks and bottoms. Consider what Robert Gordon says on pages 76 - 77 in *The Tunnel Thru the Air*.

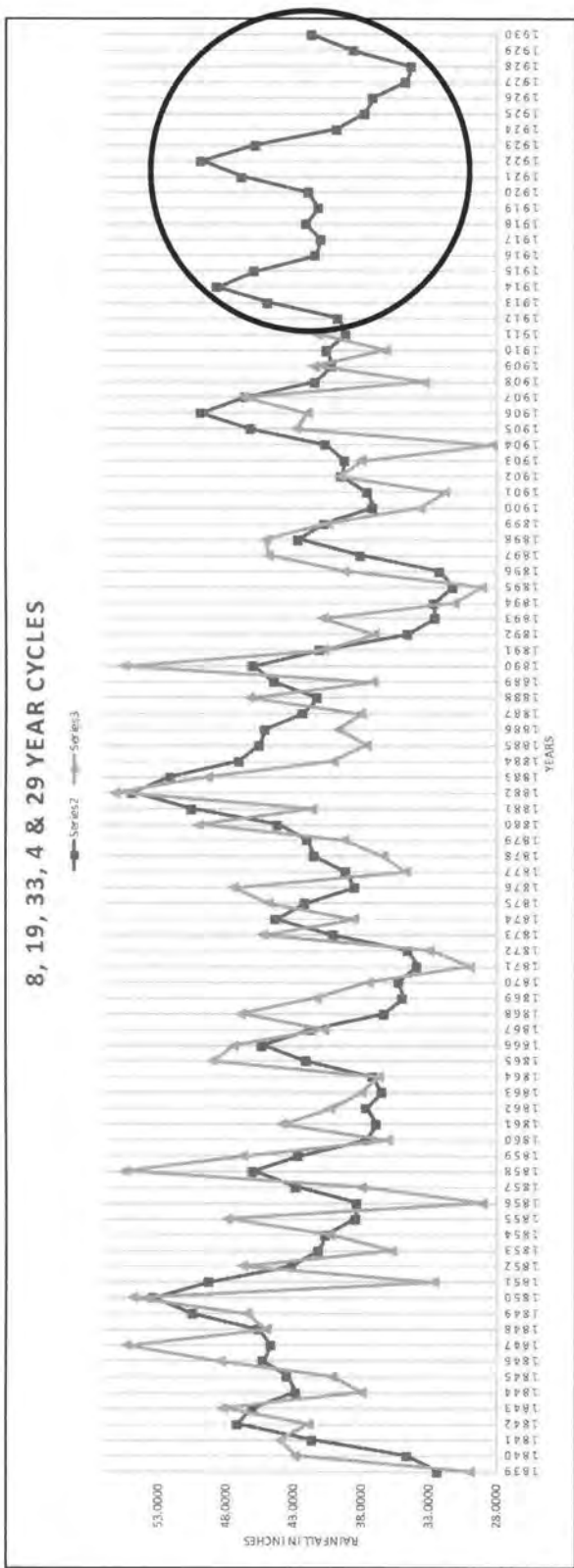
"In making my calculations on the stock market, or any future event, I get the past history and find out what cycle we are in and then predict the curve for the future, which is a repetition of past market movements."

Isn't that similar to what we just did? Obtain the past history of rainfall data in the Ohio Valley, find out the dominant cycles operating within the data, and project a curve for the future, which is a repetition of past rainfalls.



**Graph of the 8, 19, & 33-year Cycles of Rainfall in the Ohio Valley
Plotted Against a Graph of the Actual Rainfall Amounts Recorded in Inches**

Series 2 - Combined Cycles
Series 3 - Actual Rainfall Amounts



Graph of the 8, 19, 33, 4, & 29-year Cycles of Rainfall in the Ohio Valley
Plotted Against a Graph of the Actual Rainfall Amounts Recorded in Inches

Series 2 - Combined Cycles

Series 3 - Actual Rainfall Amounts

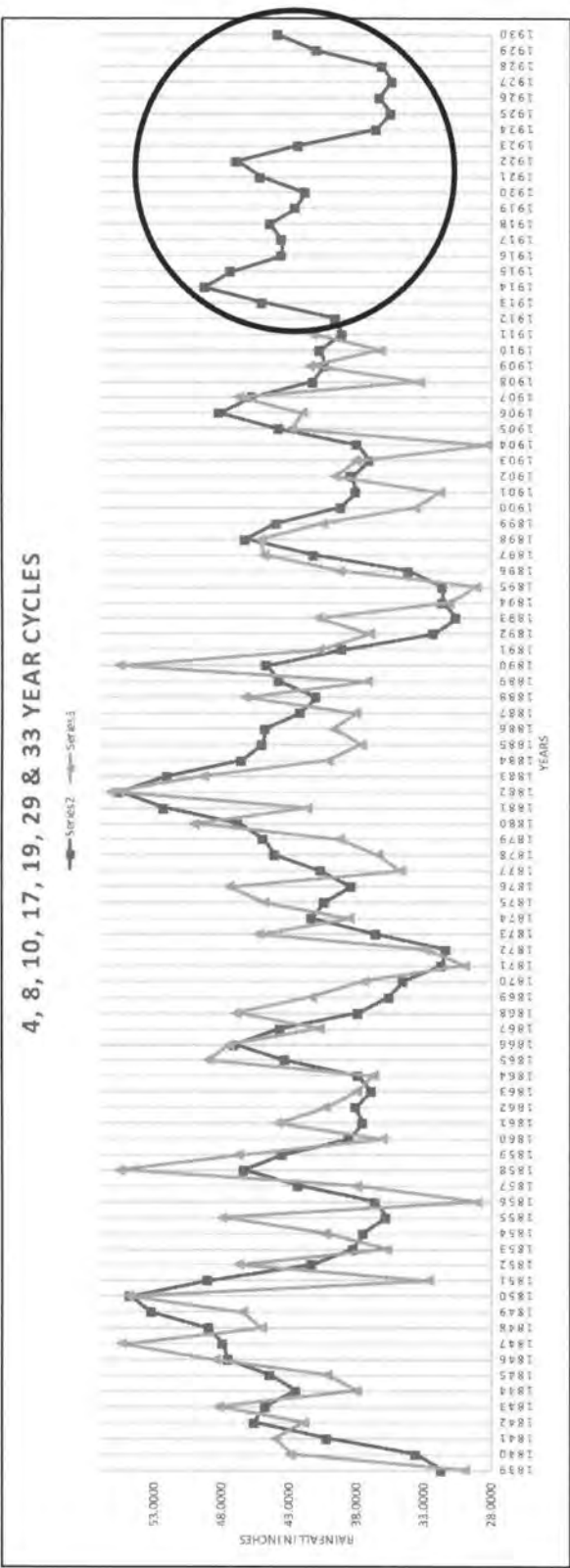
One of the most important things to realize is that the cycles identified in the Ohio Valley rainfall example may not reflect the true length of the actual cycles of rainfall. Instead of an exact 8 years, maybe the cycle is more like 8.3 years or 7.8. Maybe the cycle varies and may run 8.3 years from one peak to the next, and then 7.8 following the previous. Thus, if forecasting cycles of a standard 8 years over the long run, the forecasted peaks and bottoms may be slightly off from the actual recorded observations. It would be well to keep this in mind. To obtain a more accurate projection, it would be more advantageous to secure data that recorded rainfall amounts on a seasonal or on a month to month basis.

Another important observation is the fact that a cycle identified as dominant within the data may not be a cycle that shows up in the data as time proceeds and additional rainfall amounts are recorded. This echoes something else that the character Robert Gordon mentions in *The Tunnel Thru the Air*. On page 77 he states,

"The limit of future predictions based on exact mathematical law is only restricted by lack of knowledge of correct data on past history to work from."

If the data recorded is inaccurate, then our forecasts will be inaccurate, and if we don't have enough observations of past data to contain the true cycles in the field of investigation, our forecasts will not be as accurate. What if there were a 40 year cycle that was actually operating within the data, but due to only being able to observe 1 instance of a 40 year cycle, we would not be sure if the 40 year cycle would be factual. What if there were an 84 year cycle, but we only have 72 years worth of data to make calculations from.

As I had mentioned earlier, you can play with the data by adding and removing cycles to see how the curve changes with respect to the actual data. On the next page, you will see a graph with the cycles we have already added together with the addition of 10 and 17 years. Notice the slight changes to the curve compared with the previous curve where these cycles are not present. Now that we have seen how to perform Harmonic Analysis on actual data, we will proceed to the next chapter where we will do the same thing on stocks in the current day.



Graph of the 4, 8, 10, 17, 19, 29 & 33-year Cycles of Rainfall in the Ohio Valley
Plotted Against a Graph of the Actual Rainfall Amounts Recorded in Inches

Series 2 - Combined Cycles

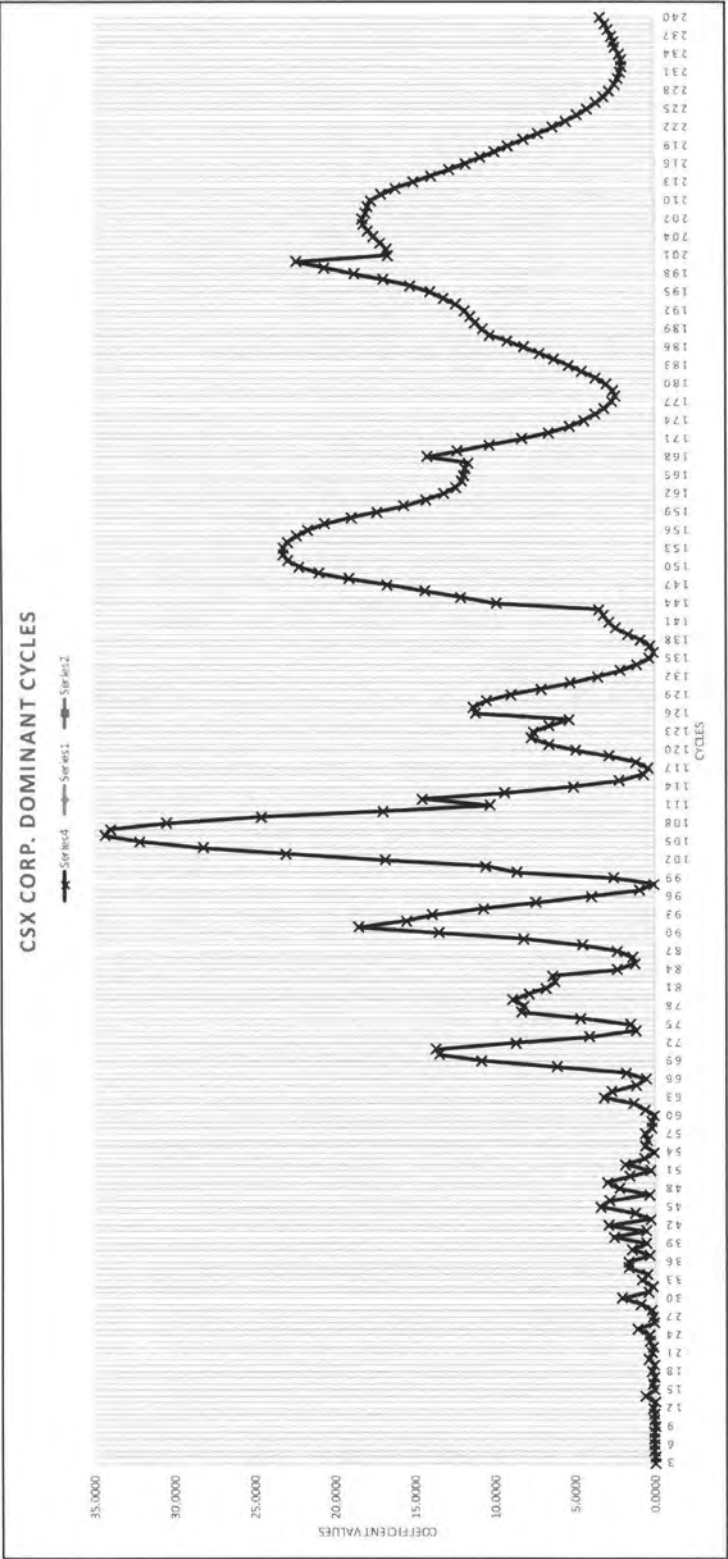
Series 3 - Actual Rainfall Amounts

4

HARMONIC ANALYSIS EXAMPLES

Having completed walking through the steps of performing Harmonic Analysis on rainfall in the Ohio Valley as given by Henry Ludwell Moore in his book, *Economic Cycles, Their Law and Cause*, we will turn our attention to its application on some stocks. First and foremost, we need the data. One of the major differences between stock price values and the rainfall data of the previous chapter is that data for stock prices is given in a range. There is a high price and a low price for a given date. Personally, what I do is take the midpoint between the high and low price and perform Harmonic Analysis on this. You could also perform Harmonic Analysis on either the high or low price just the same. It just depends on your preference.

In the first example I am analyzing weekly stock prices for CSX Corp. (CSX). The range of the weekly data starts on April 13, 1981 and ends the week of June 19, 2000. This covers a period of 1,002 weeks. After setting up my spreadsheet to perform the calculations and obtaining the constant term and coefficients of the Fourier series, I graph the squared and combined values of the coefficients to identify the dominant cycles within the data being analyzed. This graph is depicted on the following page. Notice that the 106 week cycle is the most dominant out of all the cycles ranging from 3 on up to 240 weeks. You could very well seek to determine if there are dominant cycles of more than 240 weeks, but with the amount of data being analyzed I stopped at 240. This will be more than sufficient to meet the objectives of this chapter.



Graph of the Coefficients Derived from CSX Corp. Weekly Data

April 13, 1981 to June 19, 2000

106-Week Cycle Most Dominant

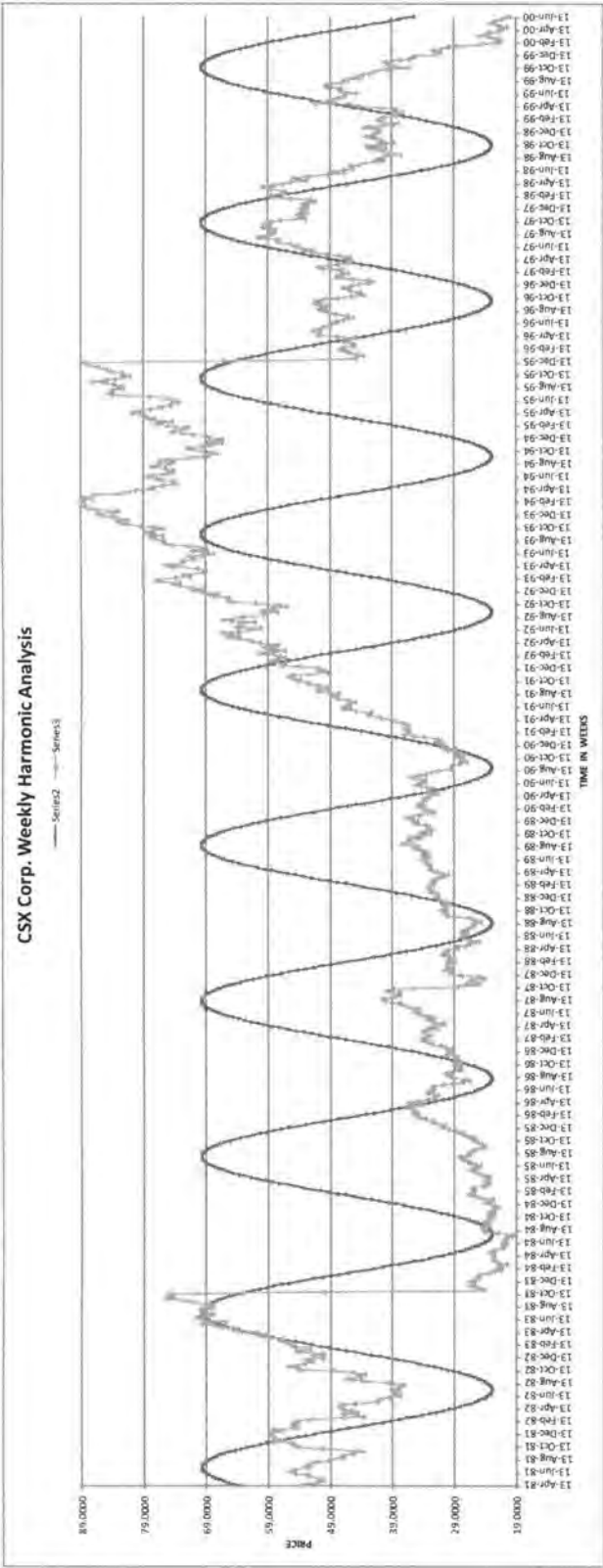
Now, if I take this 106 weeks, and plot its curve using the Fourier series formula given in the preceding chapter, I will be able to see the approximate time period when it peaks, and when it bottoms. In fact, one of the major bottoms of this 106 week wave is July 23, 1984, which was the date of one of CSX Corps most significant lows, and lasted for some time before the price went lower than this. This graph of the 106 week cycle is on the following page. Please note that due to the range of the price values, I augmented the values of the 106 week cycle 4 times their normal value so as to produce a wider swing so that you would be able to better see the peaks and valleys against the actual data.

Continuing just as in the previous chapter, we notice that there are a number of additional cycles that appear to stick out from the rest. We would want to experiment with adding these cycles to the 106 week cycle to see how they fit the curve of the actual data. After some experimentation, I used the 106, 152, 91, 71, 127, & 79 week cycles. The graph of these combined cycles is on page 41. Notice how the curve of the combined cycles is able to mimic the peaks and valleys of the actual price data.

After being satisfied with the way the curve looks against the actual price data, we want to forecast into the future. For example, let's say we would like to forecast 6 years into the future. This would be approximately 313 weeks added to the last week at the end of our data range, which was June 19, 2000. This would take us out to the week of June 26, 2006. The curve for the future 6 years is graphed on page 42. It is nothing more than a reflection of what we would expect the price values to do with respect to the cycles that have already occurred.

Now we come to the good part. We can plot the actual price values of the stock for the period after the week of June 19, 2000 up to June 26, 2006. This is the graph depicted on page 43. From June 2000, the forecast shows prices rising until early March 2001, but the actual price continues up until July/August 2001. The forecasted bottom in December 2001 is slightly off from the actual bottom in towards the end of September 2001. The up move in February 2003 to the Peak in December 2003 is right on, but the forecasted down move after this date is longer than what actually occurred. The actual up move started in March 2004. The forecast syncs back up with the actual price values in April 2005, and for the remainder of the period graphed, the top and eventual down move were accurately projected.

- Text Continues on Page 44.

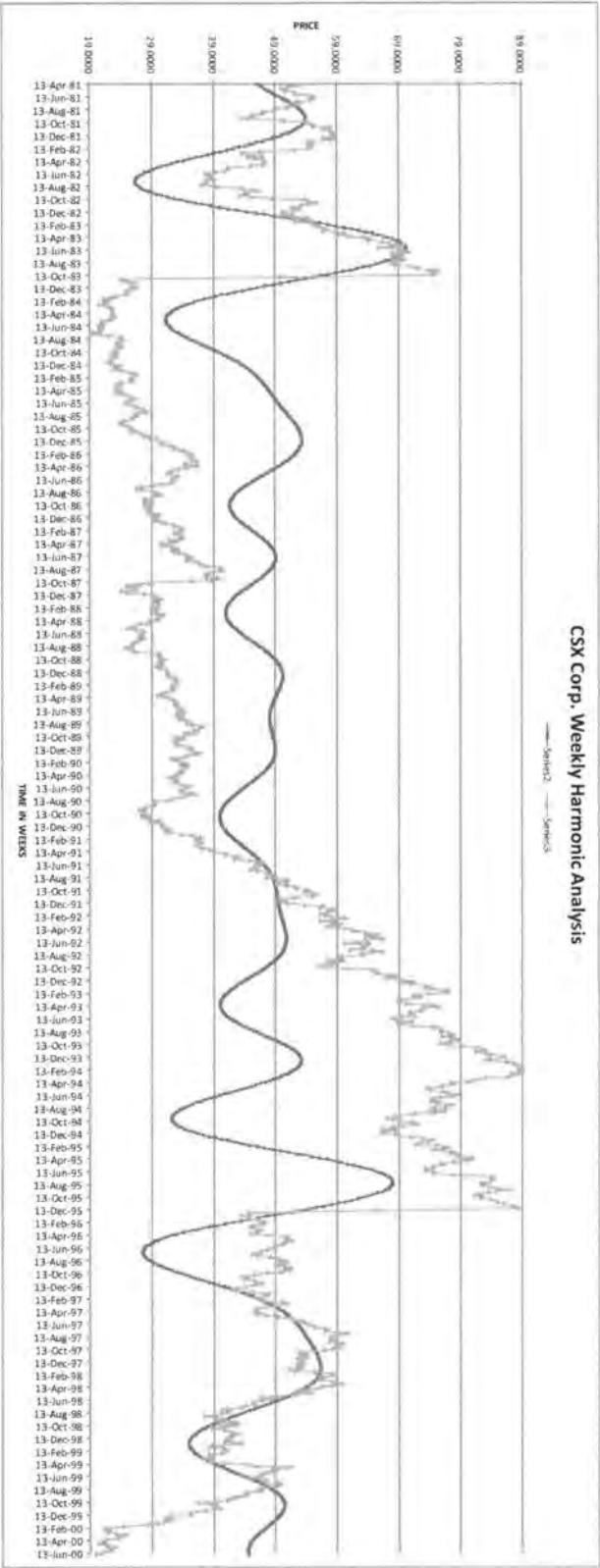


Graph of the 106-Week Cycle Against the Actual Data From

April 13, 1981 to June 19, 2000

Series 2: 106-Week Cycle

Series 3: Actual Mean Stock Price Values

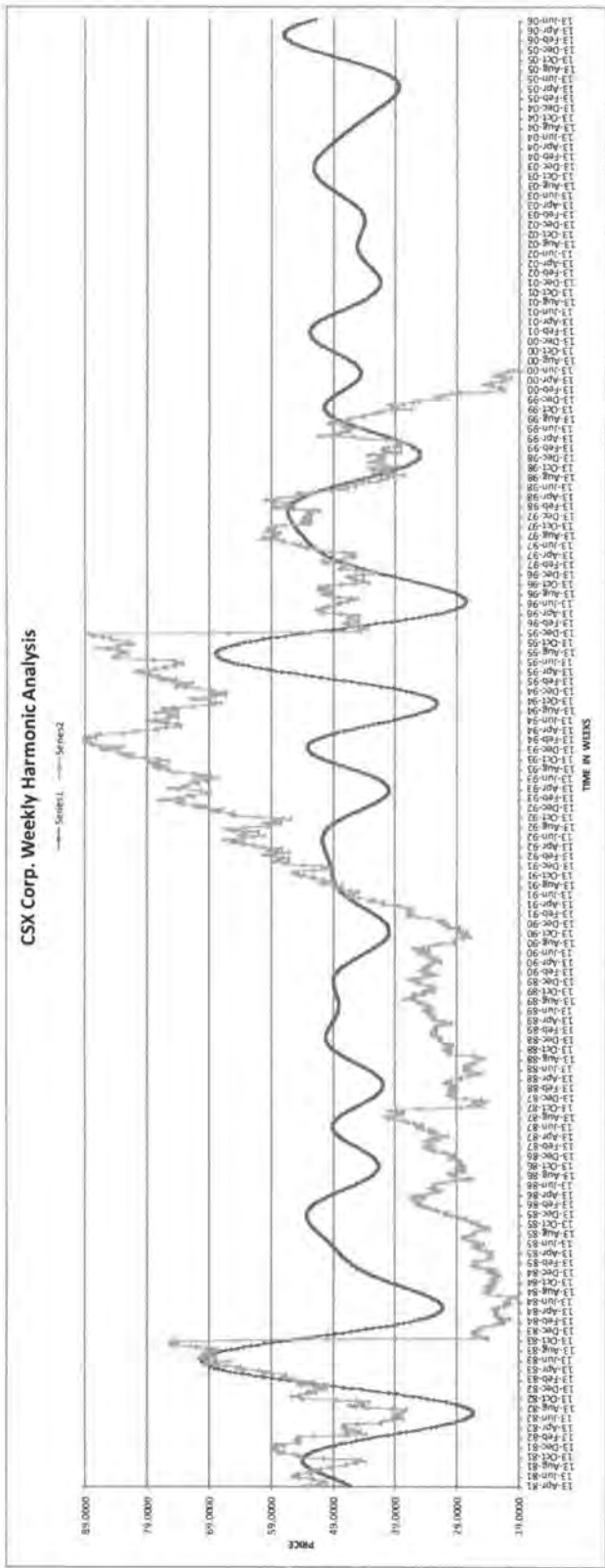


Graph of the Combined Cycles (106, 152, 91, 71, 127, 79)

Against the Actual Data From April 13, 1981 to June 19, 2000

Series 2: Combined Cycles

Series 3: Actual Mean Stock Price Values

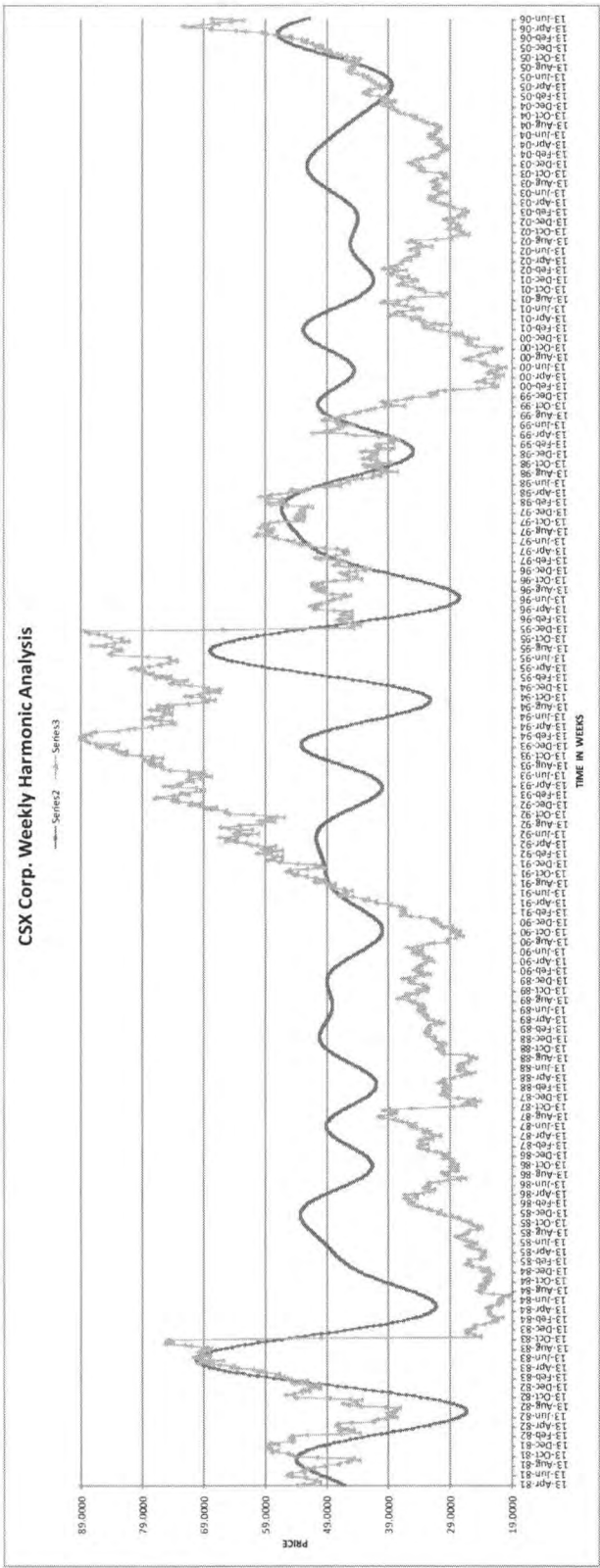


Graph of the Combined Cycles (106, 152, 91, 71, 127, 79) Forecasted out 6 Years

Past the Actual Data From April 13, 1981 to June 19, 2000

Series 2: Combined Cycles

Series 3: Actual Mean Stock Price Values



Graph of the Combined Cycles (106, 152, 91, 71, 127, 79) Forecasted out 6 Years

Against the Actual Data for the 6-Year Forecasted Period

Series 2: Combined Cycles

Series 3: Actual Mean Stock Price Values

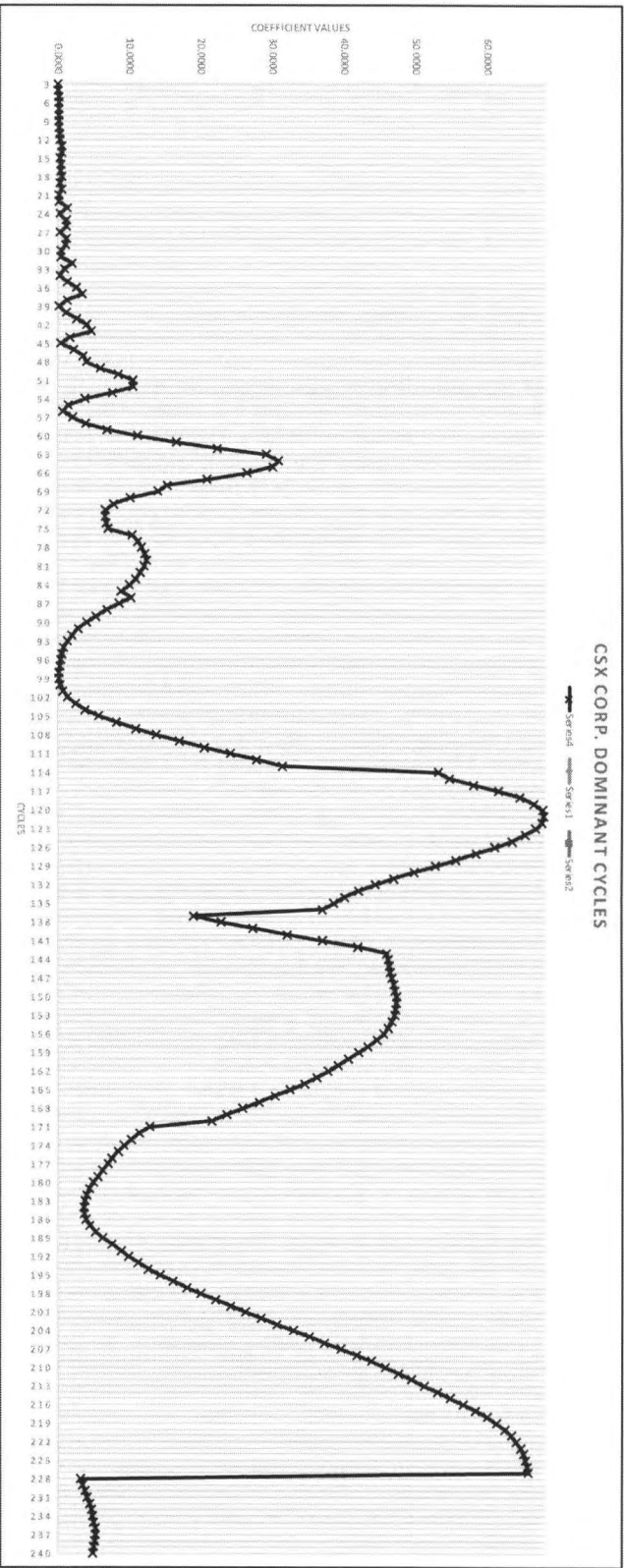
The differences in the forecast and the actual price data could be attributed to not capturing all of the pertinent cycles as I only evaluated up to 240 weeks. It could also be due to not capturing the right combination of cycles, and maybe to another one of Gann's comments as it pertains to beginning right. He said it was important to begin right in order to end right, but more can be said of that at another time. More importantly, I wanted you to see how this could be applied on an actual chart and at times, how accurate the forecasting can be. As I've mentioned in previous chapters, I am new at this and still experimenting and learning, so I don't know everything.

Moving on, I thought it would be good to show you the analysis of the same stock, but this time using a different range of data. In the previous analysis, I used data that started and ended with a heliocentric conjunction of Jupiter and Saturn. The dates are April 16, 1981 and June 22, 2000. For this next analysis, I will use data that starts with the last Jupiter/Saturn conjunction in June 2000 up to the present time because the next Jupiter/Saturn conjunction occurs on November 2, 2020. There are 683 weeks from June 26, 2000 to July 29, 2013. The graph of the coefficients is on page 45. The most dominant cycles is 121 weeks.

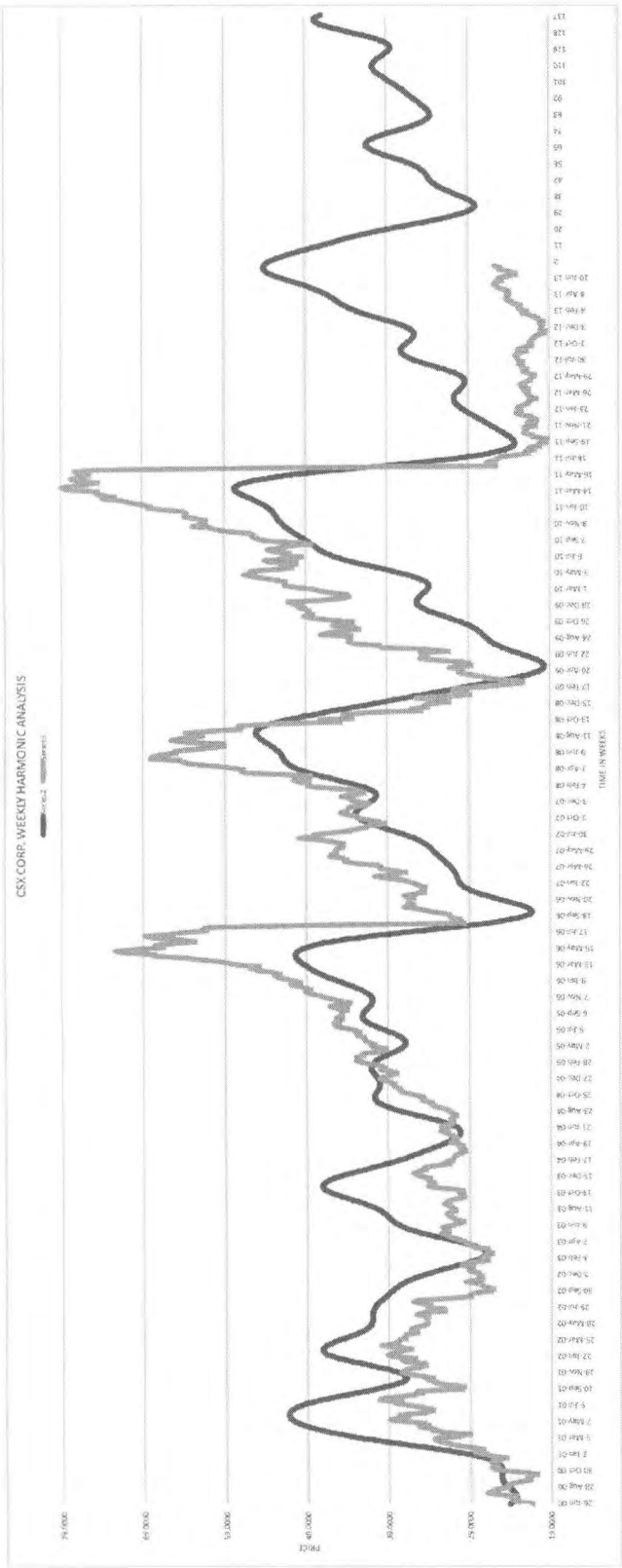
You will also notice a large spike at 227 weeks. One of the things that I've found while doing this is that there appears to be large spikes in the graph at the places that are evenly divided into the number of observations in the data. We are analyzing 683 weeks worth of data, and this number divided by 3 is 227. To be perfectly honest, I am not sure if this 227 weeks would constitute a true cycle, or if its peak is due to being a harmonic of the number of observations. I know that there were some instances in Moore's book where he would divide the coefficient value by 4, but would not do the same for others, but I have yet to figure out why. This caused the differences between the values that I calculated and the values he provided in the book.

Also worth noting is the 121 weeks is close to the 122 week spike in the first set of data. I did not include it in the combined cycles since it was secondary to the 127 week cycle, which seemed to be more prominent during this time frame. Also worth noting is the 64-week cycle that sticks out during the current time frame, and the small peak at 63 weeks in the previous data-set. The other is the 150 week peak in the current data, versus the 153 week in the previous. Some of the same cycles are present in both sets, but realize that the number of observations is less in the current set than in the previous, so certain cycles may become noticeable as time proceeds during the 2nd of the Jupiter/Saturn conjunction periods.

The graph of the combined cycles is on page 46.



Graph of the Coefficients Derived from CSX Corp. Weekly Data
June 26, 2000 to July 29, 2013
121-Week Cycle Most Dominant



**Graph of the Combined Cycles Forecasted out 138 Weeks
Against the Actual Data up to the Week of July 29, 2013.**

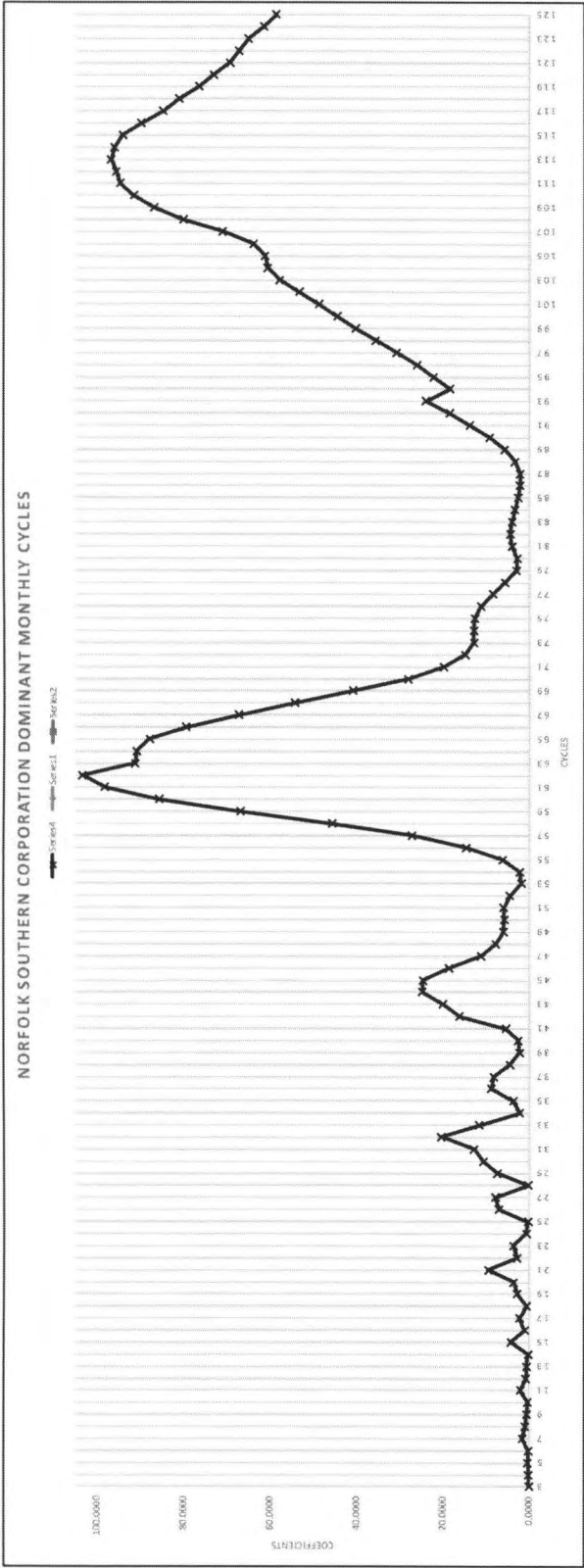
Series 2: Combined Cycles

Series 3: Actual Mean Stock Price Values

Naturally you may ask, what if instead of breaking up the data into two parts, what if you performed Harmonic Analysis on all of it and projected a future curve. As for weekly data, the amount of calculations would be enormous. I had already limited the number of cycles I was looking for within the data to 240 weeks. However, you could perform the analysis on monthly data just the same. You would then be able to ascertain cycles that are much larger than 240 weeks without the enormous amount of calculations. For example, let's look at Norfolk Southern Corporation (NSC).

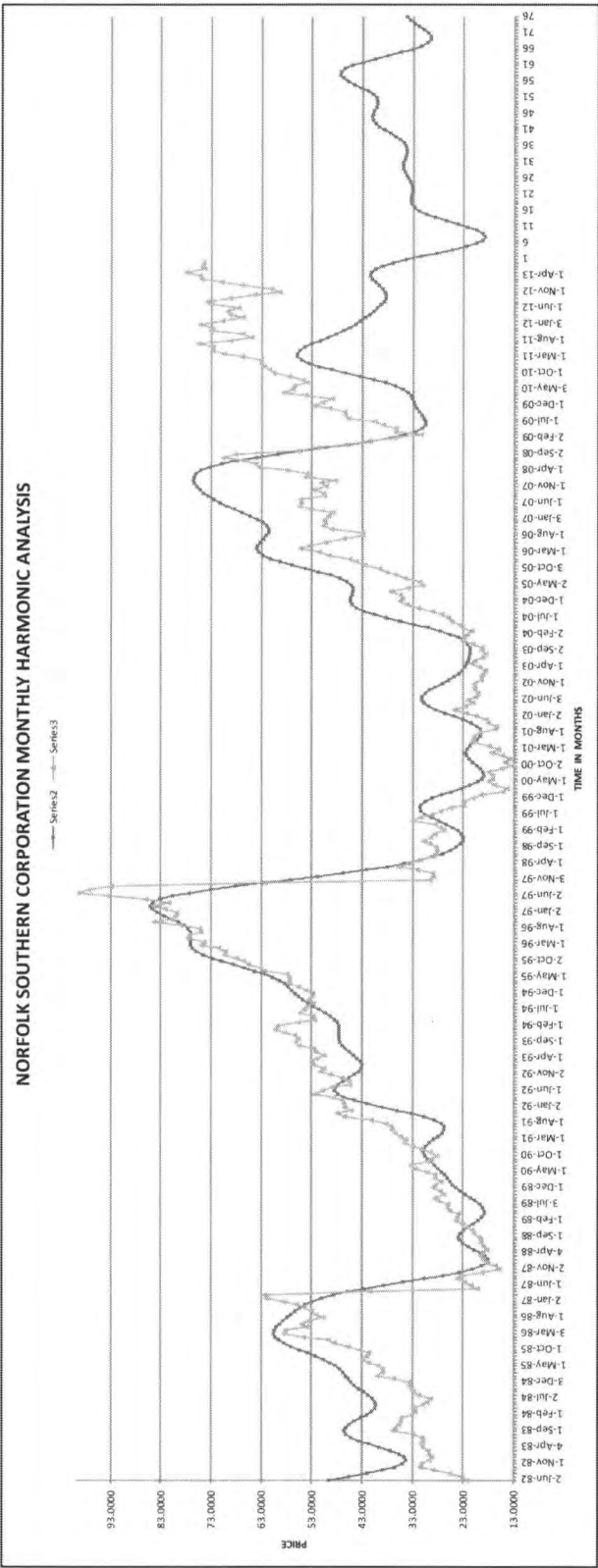
On page 48 you will see a graph of the coefficients with the months being analyzed from June 1982 to July 2013. This is a total of 375 observations. After the value for cycle 125, they get extremely large, so I cut them out of the graph. The more of these you do, you will see that the larger the cycle being analyzed, the greater the coefficient value. I think this may be due to not having as many observations of the larger cycles to determine if it consistently shows up in the data.

You will also notice that one of the cycles is 113 months. That is equivalent to approximately 491 weeks, which we would have never seen just analyzing the weekly data. Although it could very well be a harmonic of a 123 week cycle as $123 \times 4 = 492$. Combining the cycles that seemed pertinent for the data being analyzed, the graph of this curve and its forecast into the future is on page 49. The forecast is 77 months or almost 6 and a half years into the future. When Gann mentioned that you could forecast months and years into the future, I don't know of any other way where you can project a curve of that sort other than the mathematics that we are dealing with here.



Graph of the Coefficients Derived from Norfolk Southern Corporation Monthly Data

June 1982 to July 2013



**Graph of the Combined Cycles Forecasted out 77 Months
Against the Actual Data up to the Month of July 2013.**

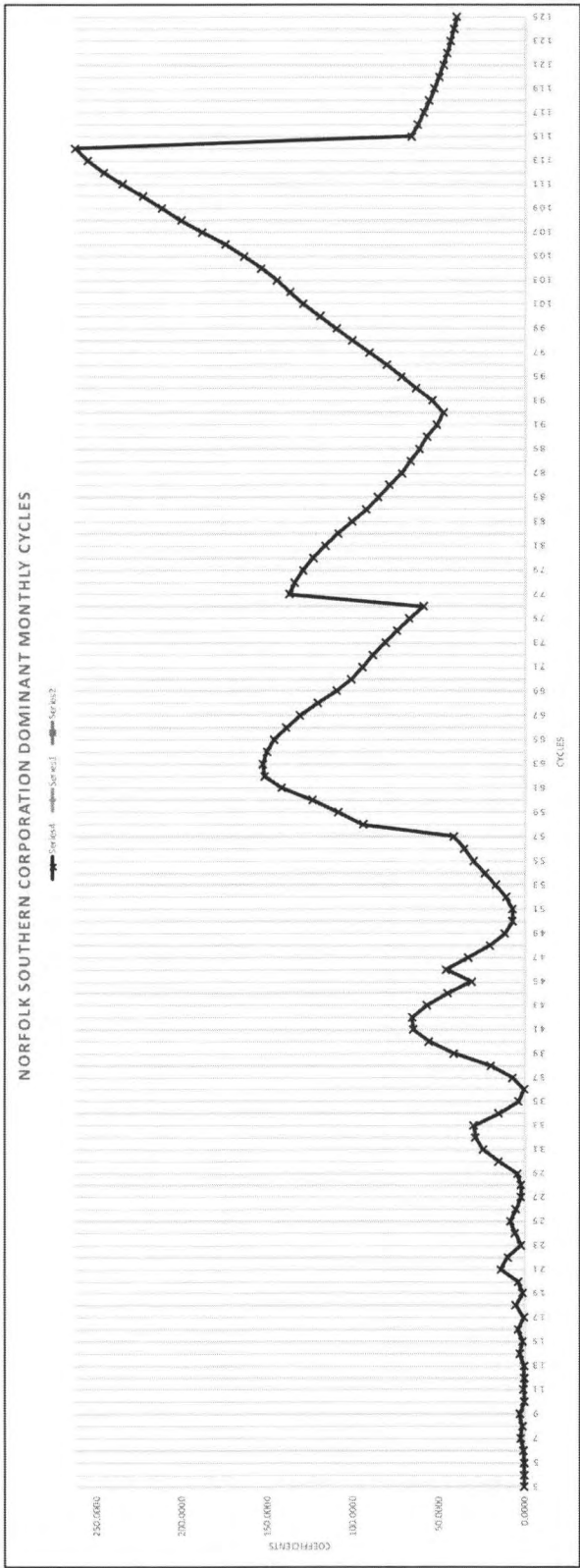
Series 2: Combined Cycles
Series 3: Actual Mean Stock Price Values

In this next example, I would like to show you something a little different. In the previous example I analyzed data that started in June 1982 and contained all of the months worth of data through July 2013. We forecasted past this point, but will not be able to see how the forecast turns out until months after this book has already gone to print. So in this example, I want to start in June 1982 again, but this time end the data being analyzed in May 2001. I want to pretend that this is all the information we have, and that we will perform our harmonic analysis on this range of data as if we have no knowledge of what future prices might be. Then we can project past May 2001 and compare the forecast to what actually occurred.

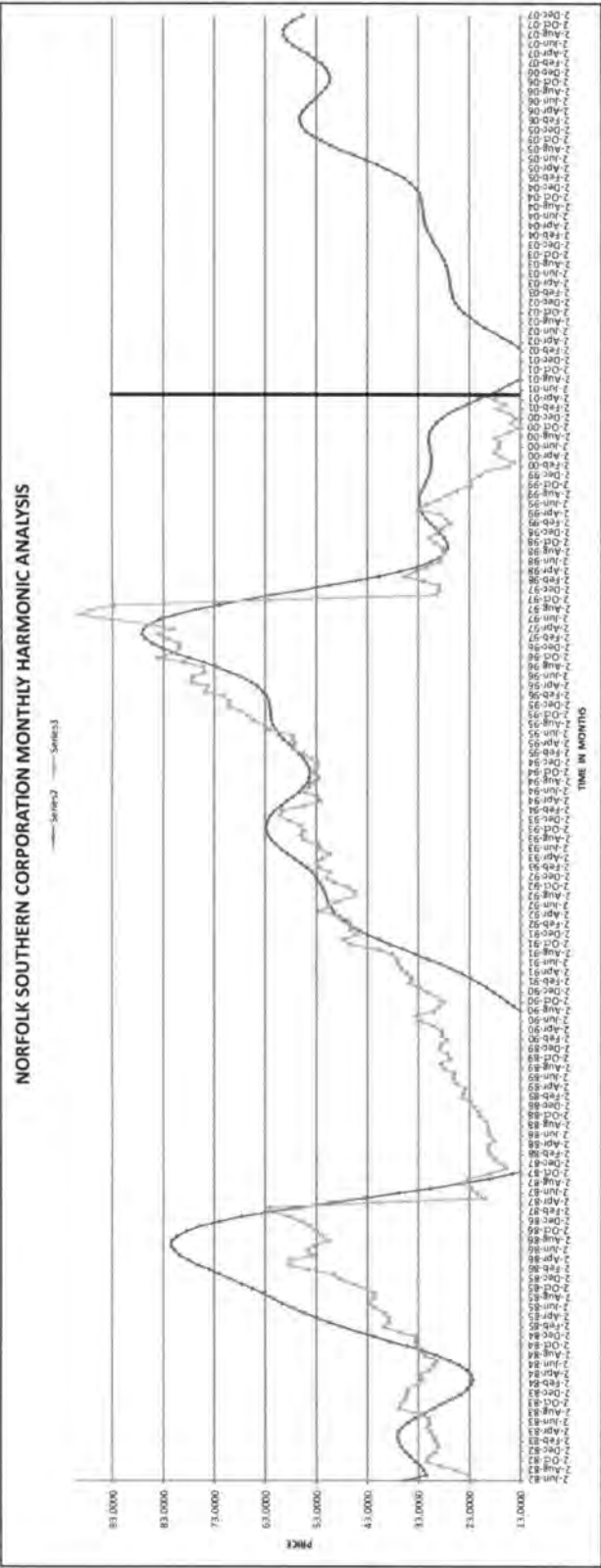
On the next page you will see the graph of the coefficients of the Fourier series for the data being analyzed. The dominant cycles that I used based on the graph and how they fit the actual price values for the data being analyzed were 63, 42, 33, 21, 25, 114, 77, & 185 months. Note, 185 months is not on the graph, as I only graphed out to 125, but I had the calculated values of the coefficients out to 187 months and saw that there was a large spike at 185 and used it to see how it worked with the other cycles.

On page 52 you will see a graph of the combined cycles along with the forecast, which goes out 79 months. This is a little over 6 and half years into the future, with the forecast ending in December 2007. Everything past the black vertical line which is on May 2001 is the forecasted period. On page 53, you will see this forecast plotted against the monthly mean stock price values recorded during the forecasted period. I will let the graph speak for itself.

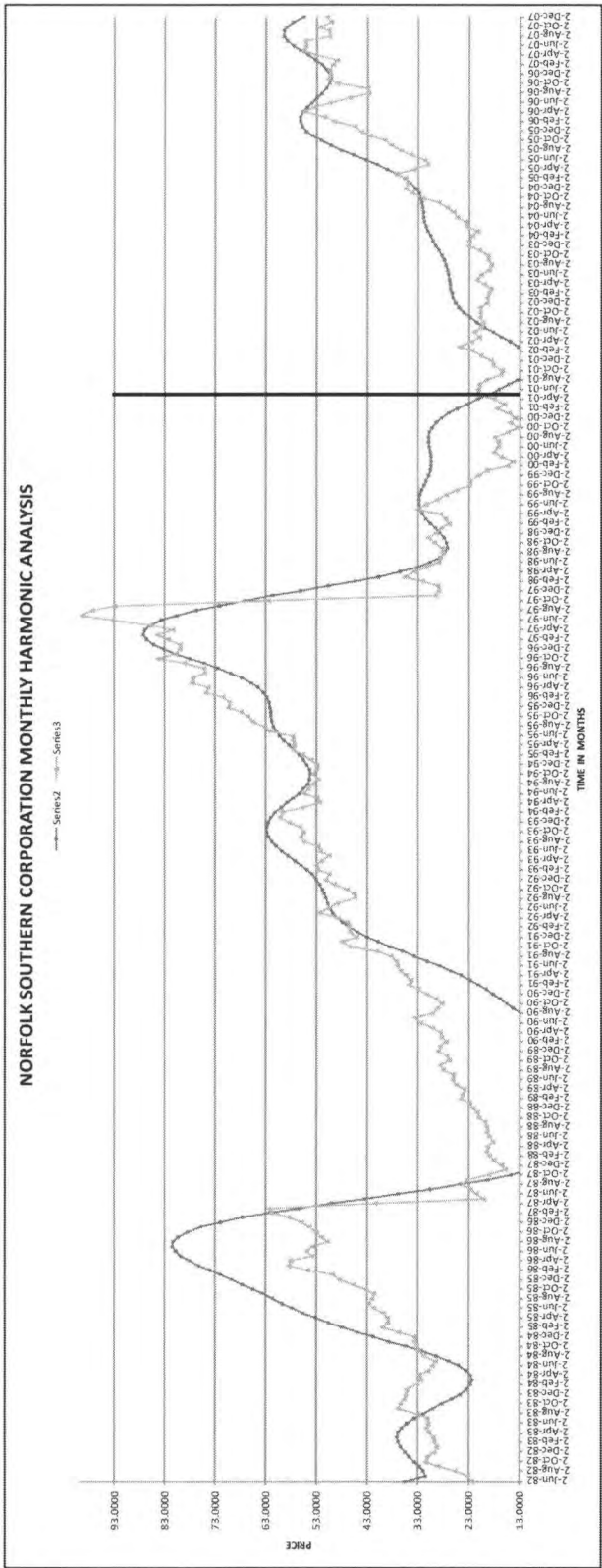
This concludes the examples that I wanted to share with readers to show how Harmonic Analysis can be applied to current day stocks. As I have stated before, I don't know everything. I am new to the subject and sure that I have a lot more to learn. The things that I have presented are examples of what I have been personally doing with this math. I am always thinking outside of the box, and I can think of a number of other ways and areas to apply this math, but further discussion on this is not the subject of this book. In the next chapter, I would like to share with the reader some additional information that I received subsequent to my initial investigation and research of the material presented thus far. For me, it was additional confirmation that Gann may have been using these mathematical techniques, and has inspired me to continue along this path of investigation with greater purpose.



Graph of the Coefficients Derived from Norfolk Southern Corporation Monthly Data
June 1982 to May 2001



Graph of the Combined Cycles Forecasted out 79 Months
Against the Actual Data up to the Month of May 2001.
Series 2: Combined Cycles
Series 3: Actual Mean Stock Price Values



Graph of the Combined Cycles Forecasted out 79 Months
Against the Actual Data Recorded for the Forecasted Period
Series 2: Combined Cycles
Series 3: Actual Mean Stock Price Values

5

ADDITIONAL CONFIRMATION

As already outlined in the preceding chapters, studying Gann's novel, *The Tunnel Thru the Air*, had led me to additional research due to the passage where a mathematical method that allowed E. H. Harriman to forecast stocks months & years in advance and that conformed to the Law of Harmonic Analysis was mentioned. From the first day I started my research along this angle, I had quit and started back several times due to not understanding what I was looking at and the complexity of the math involved. It was in March of 2013 that I had finally learned how to do the calculations and had an idea to put my findings in a book. The first 3 chapters described the events that led me to being able to reproduce the calculations in Moore's book by the end of March 2013. These chapters were started some time ago, as I had taken a hiatus from this work. It is now towards the end of August 2013 and I am fully rejuvenated to complete the remaining portions of this book.

On August 23, 2013, I checked an e-mail account that I don't regularly check, and had received an e-mail dated July 29, 2013. The subject of the e-mail stated, "Another Exciting Discovery", and it said that I may be interested in its contents. The sender was bringing to my attention another article discovered by Romeman of the Gann study group. It was a Gann article that I had never seen from *The (New York) Sun*, dated December 28, 1921. In the article, Gann is forecasting what would be in store for 1922. More importantly, the contents of the article contained additional information that Harmonic Analysis was indeed something that needed to be investigated further.

In one part of the article, it reads as follows:

"Asked to explain his method of figuring out future events, Mr. Gann refers it all to mathematical law, employed in connection with a close analysis of the past. The idea is that history of the stock market, for instance, or of the cotton market, or the weather, or influenza, or the price of pig iron fluctuates in definite cycles, and if you work out the cyclic periods, and give some intelligent study to operating causes, you can soon win promotion into the prophet class."

In addition, it reads,

"One of his stunts [Gann] is to project a curve for the stock market, showing when it should be prosperous and when depressed. In that operation he uses a system of his own, simplified from that propounded by Henry Ludwell Moore, professor of political economy at Columbia University, in his work, *Economic Cycles, Their Law and Cause*."

No way! Out of all the different books and papers that I had come across during my research, this is the one book that I thought would be best for me to learn how to perform Harmonic Analysis, and here I read about it in an article associated with Mr. Gann. Furthermore, it said that Gann was using a system of his own, but that it was a simplified form of Harmonic Analysis from that described by Moore in his book. In one moment, this made all of the frustration & countless hours dealing with the math all worth it. Yet, as you will see, there is more research to be done, more frustration to come, and countless more hours of study to put in.

At the end of the e-mail that I received, the sender had pointed out that Gann had acknowledged familiarity with Moore's work in another place. It was in a letter dated April 1, 1926 to John H. Spohn, who appears to be one of Gann's clients. This letter, which is part of a series of letters in a document entitled, *Letters by W.D. Gann to John H. Spohn and Dr. John De Jonge*, contains the following statement from Gann.

"I have read Professor Moore's book and the trouble with him was that he failed to get the right time factor and of course did not know the cause behind market movements."

Also in this same letter, Gann makes the following comment,

"You will find Schuster and Fourier theories helpful in analyzing the market."

These are the exact same theories that have been described in this book. Now in possession of this additional information, I was now convinced more than ever that Harmonic Analysis was the mathematical method of E. H. Harriman described on page 205 of Gann's novel, that is was the "Cycle Theory" of Robert Gordon, and furthermore, that Gann was using a simplified form of this same mathematical method in his own work. The question that remains is how Gann simplified the approach. This is the work that needs to be done. This is the additional research and investigation that needs to be performed.

In the article it said that Gann used a system of his own, simplified from that propounded by Henry Ludwell Moore in his book, and in the letter quoted above, Gann said that Moore failed to get the right time factor, and that he did not know the cause behind market movements. In my opinion, these are our clues as to how Gann may have simplified the method of Moore and how it may have differed from Moore's approach. In the article Gann said that if you work out the cyclical periods and put some intelligent thought to operating causes, you can soon win promotion into the prophet class. In Gann's mind, understanding the operating cause behind cycles was the key. Unfortunately, he didn't leave us many clues, but this is the lead I would like to explore in the final chapter.

6

THE CAUSE OF CYCLES

When I mentioned that Gann did not leave us many clues as to what he meant with respect to the "cause of cycles", consider the following. On page 78 of *The Tunnel Thru the Air* it says,

"How do I forecast future cycles? you may ask. In order to forecast future cycles, the most important thing is to begin right, for if we have the right beginning, we will get the right ending. If we know the cause of the effect, then there can be no doubt about predicting the future event or effect.

I have always looked for causes and when once I determine a cause I can always be sure of the effect or future event which I predict. IT IS NOT MY AIM TO EXPLAIN THE CAUSE OF CYCLES. The general public is not yet ready for it and probably would not understand or believe it if I explained it."

In the 1909 *Ticker & Investment Digest* article, Gann says,

" . . . I affirm every class of phenomena, whether in nature or on the stock market, must be subject to the universal law of causation and harmony. Every effect must have an adequate cause."

W.D. GANN: DIVINATION BY MATHEMATICS: HARMONIC ANALYSIS

In the 1922 article from *The Morning Telegraph* dated Sunday, December 17, 1922, Gann states as follows,

"The most vital is time, and back of that is the cause of recurrence of high or low prices at certain intervals. I asked Mr. Gann: 'What is the cause behind the time factor?' He smiled and said: 'It has taken me twenty years of exhaustive study to learn the cause that produces effects according to time. That is my secret and too valuable to be spread broadcast. Besides, the public is not yet ready for it.'"

This echoes what he later wrote in his novel on page 78. The cause of cycles was a secret that was too valuable to be spread broadcast. Furthermore, he tells us in two different places that the public is not ready for it. One of these passages was published in a 1922 article, and the other comes from his novel published in 1927. I believe that Gann published his first stock market course in 1931, and although he didn't think the public was ready to hear the cause of cycles up to 1927, it is in these courses years later that Gann gives some possible hints as to the cause.

If you ask some people, they will tell you he is probably talking about Astrology, but I am not so quick to use this term. Yes, he could be talking about the dynamics of the solar system as the cause behind cycles, but that is far different than simply saying it is Astrology. There is so much in the use of the word Astrology that we need to be more specific with what we mean when we use the term. Now, the evidence that planetary cycles may be the cause comes directly from one of Gann's courses. Unfortunately, I am not sure exactly which course this comes from because the material I am referencing seems to have been accumulated from a number of different courses. Despite this, under a section entitled, "How to Forecast", Gann states as follows:

"The next important major cycle is 30 years, which is caused by the planet Saturn. This planet makes one revolution around the sun every 30 years. Saturn rules the products of the earth and causes extreme high or low prices in products of the earth at the end of each 30-year cycle, and this makes Stocks high or low."

In this passage, he literally tells you that the orbit of Saturn around the sun causes the 30 year cycle and extreme high or low prices in products of the earth. I don't know of any other passages where it is this obvious.

If you recall from the third chapter where we walked through Moore's example of performing harmonic analysis on rainfall data in the Ohio valley, I mentioned the fact that the most dominant cycles in the data seemed to correspond to well-known planetary cycles. The first is an 8-year cycle, where the planet Venus returns to its same position with respect to the Earth and Sun. We identified that the first peak of the 8-year cycle occurred in 1842. If looking for an operating cause for the 8-year cycle of rainfall, Venus would be a good candidate. Likewise, Mercury would be a good candidate for the 33-year cycle as an operating cause. However, it must be noted that we could never make these associations without doing the math (Harmonic Analysis) to see which cycles were the major players in the data. This is what the majority of methods employed to ascertain the key cycles for a particular set of data is lacking.

For example, Gann mentioned that it was important to look at cycles 30, 20, 10, 7, & 5 year back to determine what the market or a particular stock would do in the future. However, if you actually do the math, you will find in the majority of cases that these cycles are not the major players in the data being analyzed. In the example for Norfolk Southern Corporation given in the fourth chapter, the most pertinent cycles for the range of data being analyzed was 159, 113, 62, 44, 36, 32, & 21 months. In years, 159 months is 13.25, and 113 months is 9.4. So we have to ask ourselves, what in the heavens could be causing cycles of these lengths? Interestingly, 7 cycles of Heliocentric Mars is 13.17 years (1.8808×7). This is very close to 13.25, and also happens to be a quarter of a 53-year Krondratiev Cycle (13.25×4). In addition, 159 months or 13.25 years multiplied by 1.5 is 19.875, which is close to the synodic cycle of Jupiter and Saturn. The 113-month cycle just so happens to be 5 orbital periods of Mars (1.8808×5), which is 9.404 years. The 62-month cycle is 1/6th of the 31 year cycle exactly, which just so happens to be a well-known cycle found in many areas, but more investigation needs to be done as to its cause. Gann often said that each stock had its own particular vibration, and harmonic analysis proves that this is indeed the case.

After determining the most important cycles for a particular stock, we have to look for the causes behind these cycles. As we know, the majority of cycles do not conform to a set period in every cycle. They actually vary from period to period where they may run longer than average in one period and shorter than average in another. I think this is why Gann said it was important to ascertain the cause. When forecasting a set cycle length, if the true cause is a cycle that varies, you won't be as accurate in your forecasts. If you know the cause, you can adjust your forecasts accordingly.

That said, there is one more piece of evidence that we can extract from Gann's courses regarding the cause of cycles. We know from various commodities courses where

Gann stated,

“We use the square of odd and even numbers to get not only the proof of market movements, but the cause.”

Think about it, he is literally saying that you can use the square of odd and even numbers to get the cause of market movements. What is it about the square of odd and even numbers that can help us determine the cause of cycles? Are these squares related to planetary cycles, and if so, how?

The square of odd and even numbers touches on a topic that I briefly mentioned in my previous book. In the chapter on periodicity, I talked about a book written by L. B. Hellenbach entitled, *Die Magie Der Zahlen als Grundlage aller Mannigfaltigkeit und das scheinbare Fatum* published in 1882. Translated from the German it reads, *The Magic of Numbers as the Basis of all Diversity and Apparent Destiny*. Based on what I could personally translate from the German, the author talked about the sevenfold periodicity in chemistry, in the musical scale, and in color or light vibrations. With all of this, the main subject of the book dealt with Magic Squares. A Magic Square is arranged so that the numbers in each row, column, and diagonal will add up to the same value. For example, the magic square of the number 3 is depicted at right.

In this square, all of the rows, columns, and diagonals add up to the number 15.

In the sixth chapter of Hellenbach’s book under a section called, “The Magic Square of the Ancients”, he writes as follows:

“The school of Pythagoras is said to have claimed that from the figures below, all of nature can be inferred from them. These figures are as follows:

Magic Square of the Number 3			=15
4	9	2	= 15
3	5	7	= 15
8	1	6	= 15
= 15	= 15	= 15	= 15

3	9	15	45
4	16	34	136
5	25	65	325
6	36	111	666
7	49	175	1225
8	64	260	2080
9	81	369	3321

We stand there in front of the magic numbers that apparently neither the periodicity nor with the number seven has a relationship with the Kabbalah. With a seer one should not take everything literally, but in a Pythagoras, one cannot simply discard everything, so what do these numbers mean?

The answer is: Who knows these numbers, knows what a magic square or tetragram is, and vice versa, who knows what a magic square or a magic circle (because the latter is in the former included) is one who knows these numbers."

Please forgive me if the translation I have provided from the German is unclear. However, I think what the author was trying to convey is the fact that it is Pythagoras who is saying that all of nature can be inferred from these numbers. Therefore, we have to pay attention to what he is saying. The consensus is that magic squares are nothing more than recreational mathematics. In other words, there is no real use for the special arrangement of numbers in these squares. Yet, Pythagoras is telling us otherwise. We just can't brush this off.

As the author implies, the series of numbers that are provided in the table are associated with magic squares of the numbers 3 through 9. The 3 in the first row is the root of the magic square of 3. The number 9 is the square of the root, and is also the total number of boxes in the square. The 15 is the total to which each of its rows, columns, and diagonals will total. The number 45 is the sum of all of the digits from 1 to 9, which just so happens to be a pyramidal number. In like manner, the rest of the numbers in the table are so derived. Hellenbach goes on to say,

"It may be noted that many of the above horizontal rows of figures were attributed to the heavenly bodies as sacred in the following order: Saturn, Jupiter, Mars, Sun, Venus, Mercury, Moon. The origin of this bland assumption is evident merely from the numbers, 3, 4, 5, 6, 7, 8, 9, the order of the apparent orbital periods . . ."

I know from other research that the planets and their corresponding numbers are all associated with where they are categorized on the Tree of Life. There is a logical explanation for why they are categorized and ordered this way, but it would take us off subject to discuss. The main thing to note is that these squares are indeed associated with the planets in some way.

After briefly describing how the numbers in the table are derived, Hellenbach goes on to write as follows:

" . . . how are these mathematical games brought into relationship with the mysteries of nature? If Pythagoras was wrong, how was it possible that he was wrong? Without a reason, a man like him could not be mistaken.

The first author known to me, who wanted to gain a practical side of these numbers is the late Prof. Lihartzik who several years ago, published a book under the title: "*Das Quadrat die Grundlage aller Proportionalitat in der Natur und das Quadrat aus der Zahl Sieben die Uridee des menschlichen Korperbaues.*"

Translated from the German, the title of Prof. Franz Lihartzik's book is *The Square: The Basis of all Proportionality in Nature and the Square of the Number Seven: The Original Idea of the Human Physique*. I have not had the opportunity to translate and get into this book as much as I would like to, but one thing I have found fascinating is how the diagrams in his book bear similar resemblance to the circles and squares in Gann's commodities courses. On the following page you will see on the left a Magic Square of 8 from Prof. Lihartzik's book, and on the right is an even square for cotton & eggs from one of Gann's commodities courses.

Continuing in Hellenbach's book, we learn that he creates a 7 X 7 magic square of the notes of the musical scale, which allowed him to see relationships between the notes that are not present otherwise. Then, in another section of the book, he recounts how he came upon the idea to put the years of his life in a 9 X 9 magic square, and based on the relationship of the years, he was able to identify periods that corresponded to key periods and events in his life. What is even more interesting as it pertains to the subject at hand is the fact that I found the same things discussed in a book published in 1893 entitled, *Magic Black and White, Or, The Science of Finite and Infinite Life* by Franz Hartmann. It is noteworthy because what he writes in relationship to these things sounds a lot like Gann. On page 125 Hartmann begins as follows:

"In every department of nature every effect depends on a corresponding cause, and every cause will produce a certain affect according to the conditions in which it becomes manifest. If we knew the causes we could easily calculate their effects."

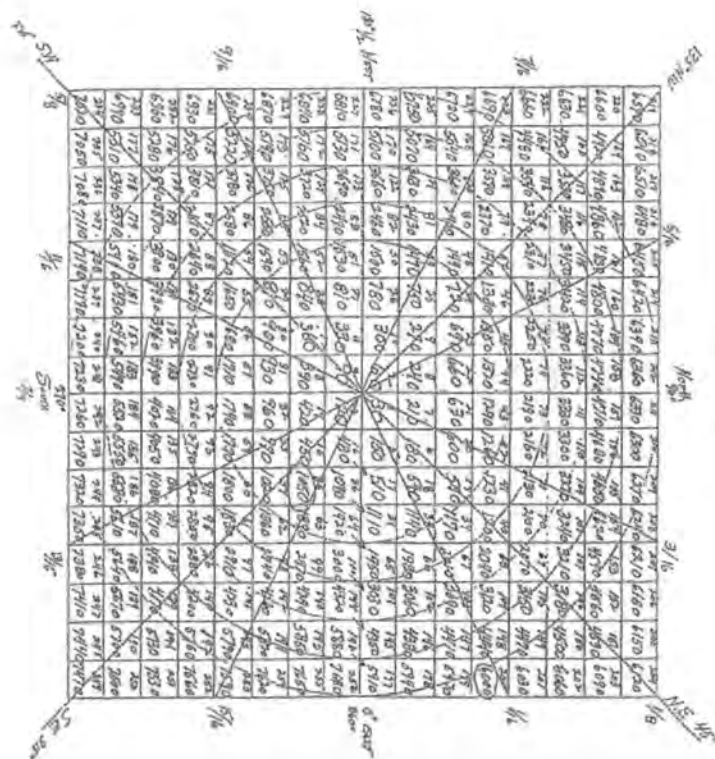
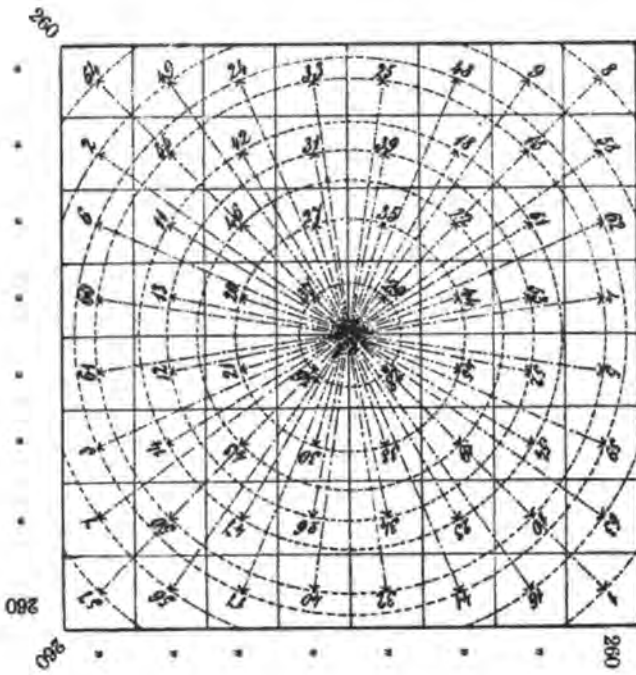
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24.



He continues on page 128 by saying,

"Everything has its number, measure, and weight, and there is nothing in nature which is not ruled by mathematical laws. . . The followers of Pythagoras believed every process in nature to be regulated by certain numbers, which are as follows:

3	9	15	45
4	16	34	136
5	25	65	325
6	36	111	666
7	49	175	1225
8	64	260	2080
9	81	369	3321

This table represents a succession of numbers, which are obtained by the construction of Tetragrams or magic squares, and it was believed that by the use of these numbers every effect could be calculated if the original number referring to the cause were known. If everything has a certain number of vibrations, and if these vibrations increase or diminish at a certain ratio and in regular periods, a knowledge of these numbers will enable us to predict a future event."

This is the same table and mention of Pythagoras that Hellenbach has in his book published in 1882, and the same table from page 50 of Liharzik's book published in 1865. Liharzik quotes the source for this material to Athanasius Kircher's 1665 publication of *Arithmologia sive De abditis numerorum mysterijs* (Arithmologia or the Secret of Numbers Mysteries) pages 57 - 59.

Franz Hartmann goes on to mention the same scale of 7 in music, light, etc., and even shows us how to construct the magic squares of odd and even numbers. Continuing in Hartmann's book, in the footnotes starting on page 131 and continuing to page 132, he writes,

"Every person has a certain number that expresses his character, and if we know that number, we may, by the use of the magic squares, calculate certain periodical changes in his mental and emotional states, which induce

him to make certain changes in his outward conditions, and in this way calculate approximately the time when some important changes may take place in his career.”

It reads as if Franz Hartmann knew how to use magic squares for something other than recreational mathematics. So the question remains, are the magic squares described by Kircher, Liharzik, Hellenbach, and Hartmann somehow related to the squares of odd and even numbers that Gann used in his work? Gann said himself that we could use the square of odd and even numbers to get the cause of market movements. He has stated in different places that

“Every movement in the market is the result of a natural law and of a cause which exists long before the effect takes place and can be determined years in advance.”

“Every price at which a stock stops on the up or down side is some important mathematical point, which can be determined either by a division of the circle of 360° or by the square of 12, the square of 20, or the square or half-way point of some other number. There is no top and bottom price which cannot be determined by mathematics. Every market movement is the result of a Cause and when once you determine the Cause, it is easy enough to know why the Effect is as it is.”

Even though the digits of a magic square are arranged differently than the numbers in Gann’s Price/Time charts, I think it would be foolish to rule them out for further investigation. Once again, there is a wealth of information yet to be explored and understood in the books I have referenced in this work as to the cause of cycles. Maybe Kircher’s book, *Arithmologia*, was one of the ancient books on geometry and mathematics that Gann mentioned in the 1919 article.

That said, I will bring this small book to its conclusion. I hope you found the presentation of harmonic analysis and the discussion on the cause of cycles beneficial. It is my heartfelt wish that you were able to find something valuable within these pages to continue your own research without having to spend hundreds, or even thousands of dollars to do so.

Peace & Blessings, Awodele

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Pronicorum proprietatibus. 59

CAPVT I.

De miris numerorum effectibus.

AEgyptios, philosophos certos quosdam, eosque arcanissimos numeros habuisse, septem principalibus Dijs dedicatos, certum est; quales autem hi numeri fuerint, quibusue Dijs dedicati, aut quos usus habuerint, demonstrabimus. De his sic Abenuaschia de cultu Aegyptiorum; Meminerunt Philosophi Aegyptij, quod erant ipsis septem numeri in magna veneratione, quos & septem Dijs eorum consecrabant; videlicet, Saturno, Ioui, Rephan siue Marti, Soli Veneri, Mercurio, & Luna. Saturno dedicabant hosce numeros 3. 9. 15. & 45. Ioui hos 4. 16. 34. & 136. Marti hos 5. 25. 65. & 325. Soli hos 6. 36. 111. & 666. Veneri hos 7. 49. 175. & 1225. Mercurio hosce, 8. 64. 260. 2080. Luna denique, 9. 81. 369. & 3321. Habemus numeros; iam quod mysterium, sub ipsis lateat, & originem vnde nanciscantur, videamus.

Dijs qui numeri dicati.

Also Available by the Author

W.D. GANN

DIVINATION BY MATHEMATICS

In reading and studying Gann's novel, *The Tunnel Thru the Air or Looking Back From 1940*, a certain set of passages had always grabbed the author's attention and he wondered what Mr. Gann may have been referring to. This book is a result of his investigations concerning these passages, which concerns itself with what Gann calls in his novel, the Law of Harmonic Analysis.

In the author's previous work, *W.D. Gann: Divination By Mathematics*, published in June of 2013, he pointed out that Astrology was not the main factor that Gann utilized to forecast future events. Even Gann said that in the 1919 *Milwaukee Sentinel* article which is analyzed in that book. In the article, Gann uses the science of letters and numbers to make predictions regarding the German Kaiser, Wilhelm Hohenzollern. In the analysis of that article, the author showed how Gann may have used cycles and geometry to forecast the specific dates and periods mentioned. In this second book, the author continues with the mathematical aspect of Gann's work, the foundation of which, is based on a couple of passages within Gann's novel, *The Tunnel Thru the Air*. The author shows us that Gann was indeed trying to tell us something valuable in these passages, and this book outlines the author's research & investigation into what he believes Gann was talking about, and the application of those findings. You will learn how to apply the mathematics being presented, which is explained in simple terms for the non-mathematician.

Gann was consistent in saying that mathematics was the basis of his forecasting methods. The material presented in this book is consistent with what Gann has always said.

It is the hope and desire of the author that this work will inspire others to continue research into Gann's work along these lines. Even Gann said that Astrology failed, that something else had to be added into the equation.

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ISBN 9780615882079



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